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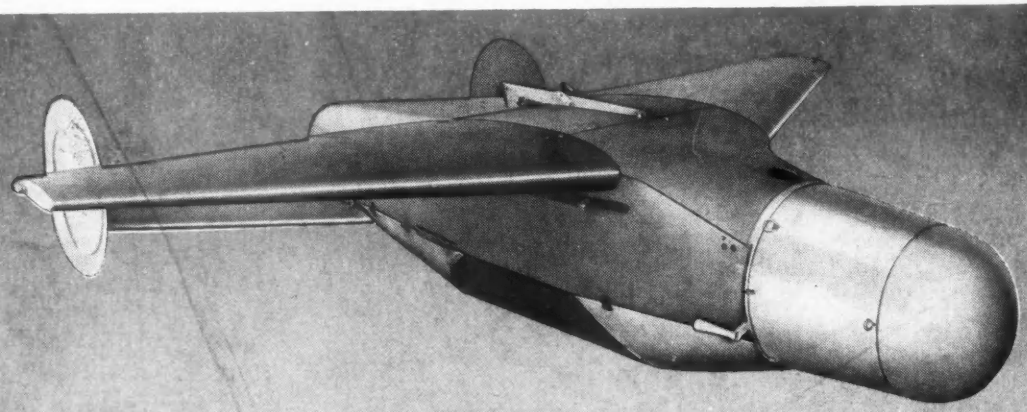
AUTOMOTIVE and Aviation INDUSTRIES

JANUARY 1, 1947

The secret weapon no Jap ship could dodge



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Story of the NAVY BAT*

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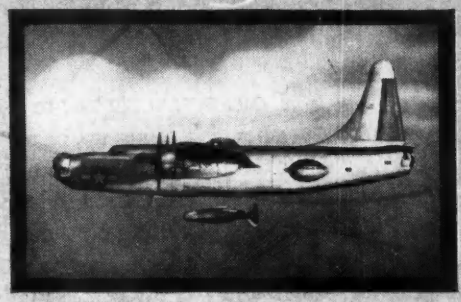
That was the urgent question. And American genius answered with the Navy Bat—a radar-guided glider bomb.

Designed to glide silently at 300 miles per hour—with a 1,000-pound bomb in its belly—the Bat was carried by a Navy patrol bomber.

At a point five miles from the target, the "mother" plane would aim the Bat at a Jap ship and release it. From then on the Bat automatically followed every twist or turn of the enemy ship—and smashed into the dodging Jap.

Used against Jap destroyers, tankers, picket boats—and land installations—this weapon was so effective the enemy thought we had a suicide pilot inside each Bat.

Instead, the Bat contained revolving radar gear to search for the target—and tiny gyroscopes to correct for errors in flight.



"Mother" plane—five miles from target—aims the Bat, releases it, and turns away from enemy anti-aircraft fire. Bat glides ahead.

and its 36 BALL BEARINGS

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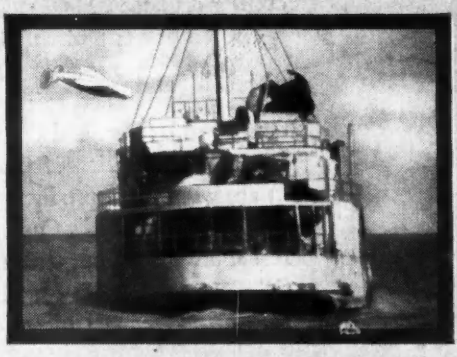

Automatically following every change in course of enemy ship—the Bat hits the target. First such weapon successfully used in combat by any nation. (*Sponsored by U. S. Navy Bureau of Ordnance and Bureau of Standards, the Bat is 12 feet long, has a 10-foot wing span. Official U. S. Navy photographs.)

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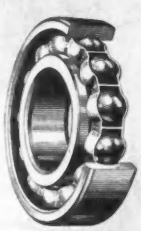

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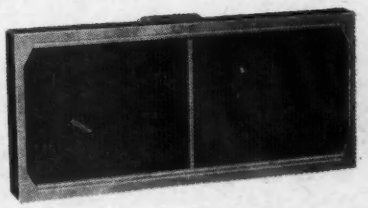

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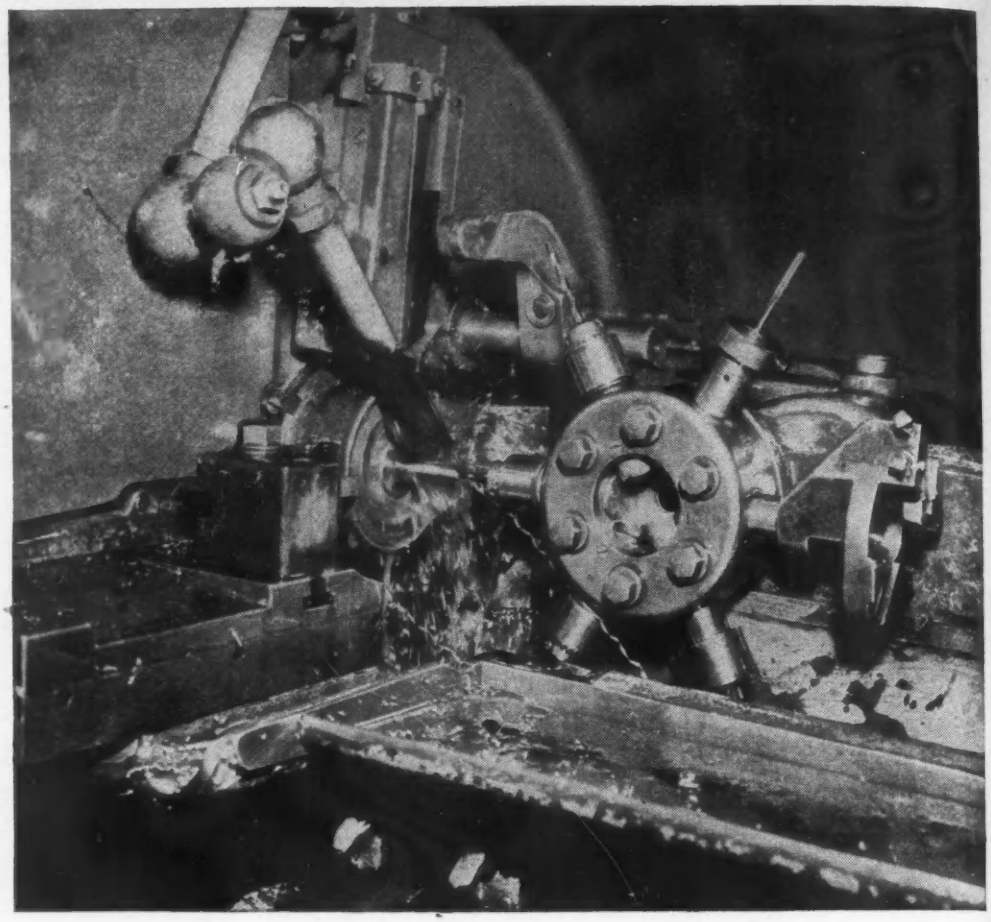

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the first and 15th of the month

January 1, 1947
Volume 96, No. 1

It Must Be Far Enough

By Julian Chase

THE new Congress is about ready to begin serious consideration of the chief business at hand. It is important business, vitally important business, but it is by no means new business. It is business that should have been attended to, adequately and effectively, long ago. Now it is the business of undoing, much more than it is the business of doing. Selfishly cultivated false conceptions must be corrected. Fundamental principles must be reestablished. Definitions and distinctions, especially as between basic rights and tolerated privileges, must be clarified to a point at which there can be no possibility of confusion or misunderstanding.

Beyond question, as things stand at the moment, the major task with its consequent outstanding responsibility that has been dropped directly into the lap of the new Congress by friends on the outside and enemies on the inside of organized labor is the quick and firm establishment of orderliness and commonsense in the field of labor relations. Unless we promptly set things right in this respect, our own national future will, to say the least, be seriously imperilled and our influence on world affairs will be drastically curtailed if not actually reduced to the vanishing point. The solution of our labor problems comes first, therefore, in the interest of both national and world-wide wellbeing.

Certain trends of the times must be terminated and, in fact, turned around. The growth of the power of irresponsible and often unscrupulous labor leaders must be stopped. The increasing usurpation of individual rights must be abruptly halted. The extension of labor monopoly must be brought to an end. All of these and other similar developments resulting from warped thinking and opportunistic grasping must be reversed and, in retrogression, made to conform to sound constitutional conceptions or be totally eliminated.

Constitutionally labor unions have no rights that are not also the inherent rights of all of us. Of late they have been indulged like the spoiled children they have, in many cases, proved themselves to be. They prate much about alleged rights of a special character which, if they can be substantiated to any worthwhile degree, have been acquired through over-patient sufferance and the suffering of others including their own members as individuals. Belief in the existence of such seeming rights has been implanted and fostered in the popular mind by the Hitlerian method of employing repetitious falsity. The effort obviously has been to acquire squatters' rights on individual liberty. It is time to act against such wanton trespassing.

It is time to act, to act dispassionately but with thorough efficaciousness. It is time to act with good judgment but decisively. There are those who counsel moderation for social, political or selfish reasons. There are some who fear that Congress may either act too drastically or lean too far backward in an effort to avoid doing so. Let us hope that Congress will not go too far but will, most certainly, go far enough. Under the present intolerable conditions, that will have to be pretty far.

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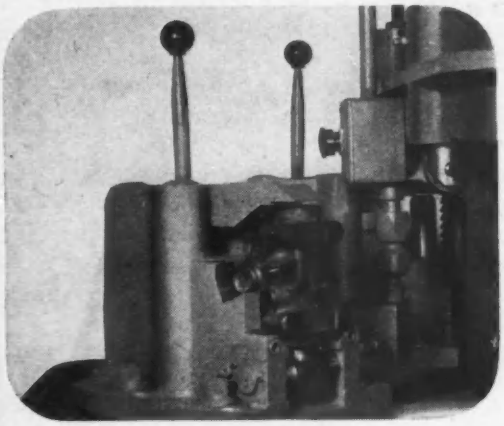
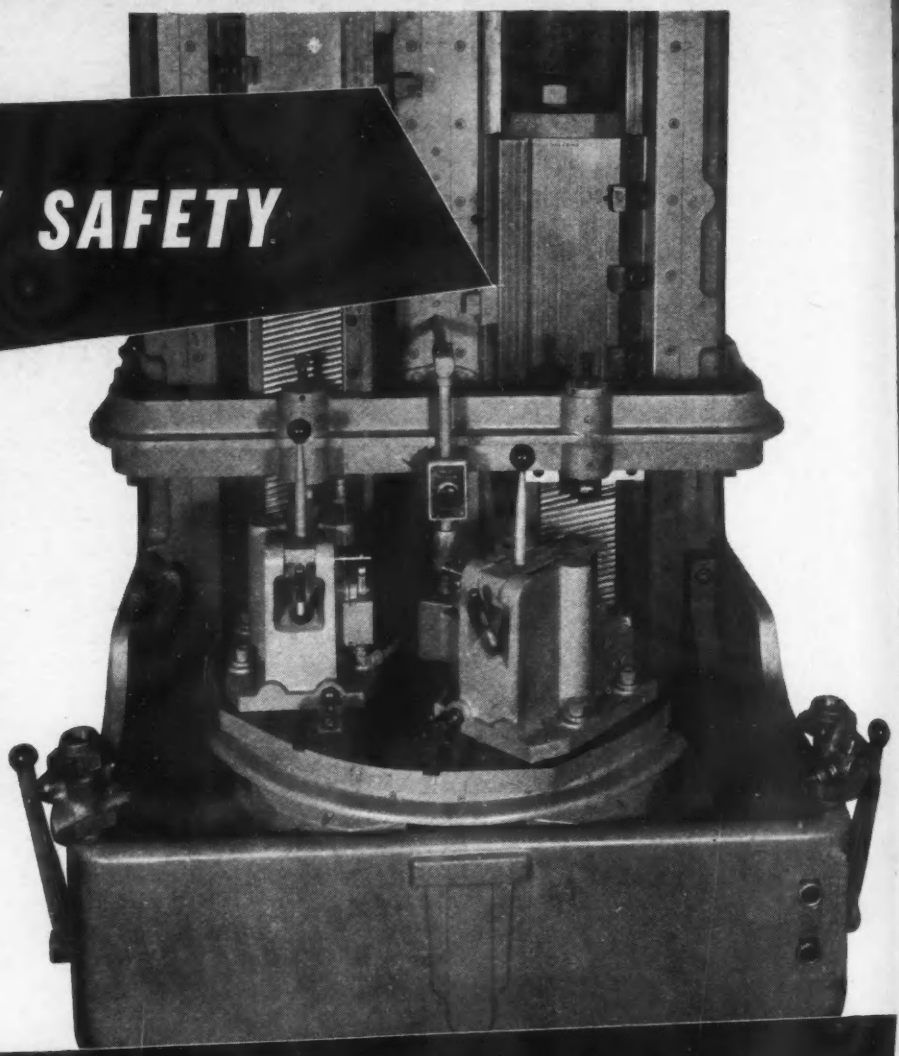
TWO-WAY SAFETY



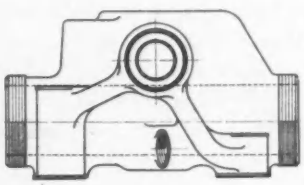


Above: Close-up of right-hand fixture with parts in position for broaching. Clamp levers must be vertical before table will index.

Right: CINCINNATI No. 5-54 Duplex Vertical Hydro-Broach tooled up by Cincinnati Application Engineers to broach mounting pads on shock absorbers.

CINCINNATI

WHILE BROACHING 578 PARTS PER HOUR



Part name—Shock Absorber Body
Material—Cast Iron
Operation—Broach Mounting Pads
(Broached surfaces shown in color)
Stock Removal—Approximately .090"
Production—578 per hour
Machine—CINCINNATI No. 5-54 Duplex Vertical Hydro-Broach, with tooling by Cincinnati Application Engineers

● Because of built-in features, safety for himself or the equipment causes no worry to the operator of this machine. In the first place, clamping is automatic, actuated by the swiveling motion of the table and spring loaded rollers in the bridle type unit above the fixtures. This alone relieves the operator of much physical and mental effort. Secondly, and very important in maintaining a clean record of lost time accidents, is the safety interlock built into the fixtures. The machine table cannot index until the fixture is properly loaded and the clamp lever returned to the vertical or closed position. Thus the setup assures two-way safety (safety for operator and safety for equipment) while operating at a high rate of production. ¶ This is another example of Cincinnati Application Engineering in the field of surface broaching. Our engineers will be glad to talk broaching with you, on small lots of family groups or millions; narrow broach-sawing or wide surfaces; flat or curved surfaces. Be sure to include complete details when writing. For engineering specifications on CINCINNATI Duplex Vertical Hydro-Broach Machines, ask for catalog No. 1387-1.

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View of some of the aircraft and models at the 1946 International Aeronautical Salon. The helicopter in the foreground is an Aerocentre NC 2001 model with twin two-blade rotors. It is intended as a five-place transport type. (Acme photo)

Paris Postwar

THE 1946 Paris Aeronautical Salon in November, 17th of the series, was France's first postwar international exhibition of aircraft and allied equipment. Hard hit during the German occupation and now faced with tremendous reconstruction difficulties, the French are making a brave attempt to regain their prewar place in the air. The show, however, was dominated by Great Britain with a display of jet reaction engines. Not only had every British airplane and engine manufacturer a booth in the hall, but the entire and multifarious accessory industry was represented.

The RAF gave willing assistance in transporting and erecting planes in the exhibition hall, and inaugurated the first international service of a plane with jet-reaction engines, during the first days of the show. A Lancastrian, powered with two Rolls-Royce piston engines and two jet-reaction Nenes, made the journey from London to Paris in 50 min, gave demonstrations over and around the city, flying on its jet engines only, then returned to London in 41 min flying time, at an average of 322 mph. Weather conditions were bad.

American representation did not comprise a large segment of the aircraft industry of that country. Pratt & Whitney, Curtiss Wright, Continental Motors, and Hamilton Standard Propellers had exhibits, but there were no aircraft other than models, and in some cases merely a mural display by air transport companies. To the uninitiated general public Czechoslovakia was more important than the United States. Italy was represented by Fiat, with models only, and Fokker was present for the Dutch industry.

The French aviation industry having been nationalized, nearly all the old familiar names have disappeared and have been replaced by initials which are meaningless to most people. Briefly, the industry has been divided into four groups for aircraft production and one for engines. These are known as the national factories of the North, South-East, South-West, and Center. The State has 90 to 95 per cent of the holdings in these different companies. The make-up, broadly, is as follows:

National North:

Sartrouville (Cams-Potez)

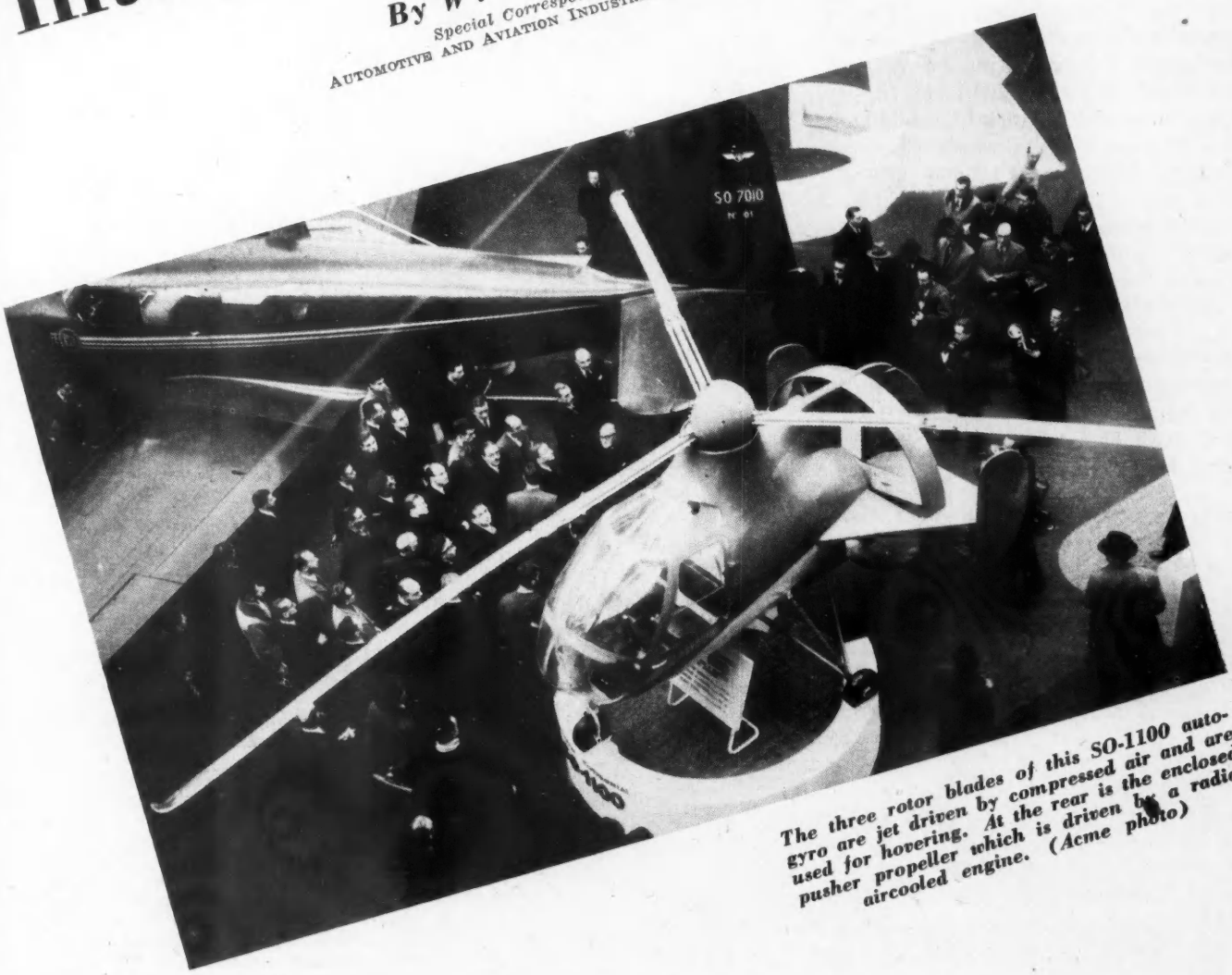
Les Muraux (Potez)
Méault (Potez)
Le Havre (Potez)
Issy-les-Moulineaux (Potez)
National South-East
Toulouse (Dewotine)
Marignac (Potez)
Cannes (Romano)
National South-West
Suresnes (Bleriot & Farman)
Courbevoie (Prototypes)
St. Nazaire (Nieuport)
Bougnet (Breguet)
National Center
Issy-les-Moulineaux (Nieuport)
Billancourt (Farman)
Chateauroux (Bloch)
Bourges (Henriot)

Engine construction is grouped in the S.N.E.C.M.A. (Societé National de Construction et d'Etudes de Moteurs d'Avion), the main factories be-

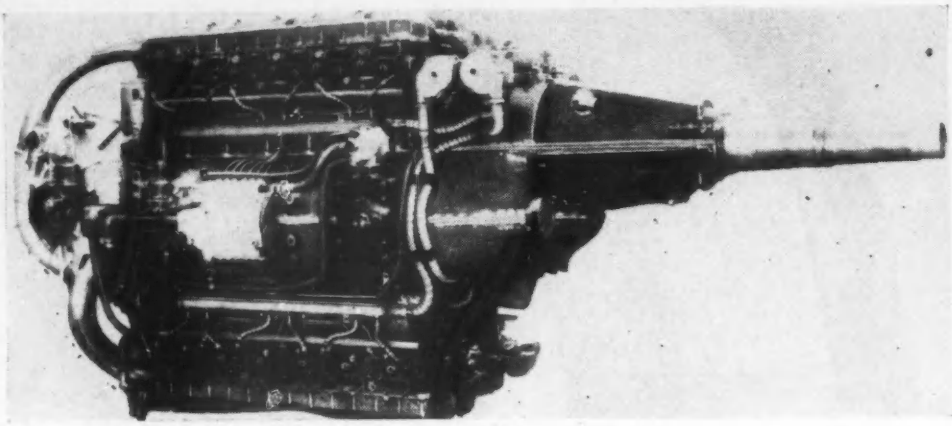
First Postwar Salon Symbolizes France's Effort to Regain Prewar Place in Aviation. Great Britain Well Represented

International Air Show

By W. F. Bradley
Special Correspondent of
AUTOMOTIVE AND AVIATION INDUSTRIES in France

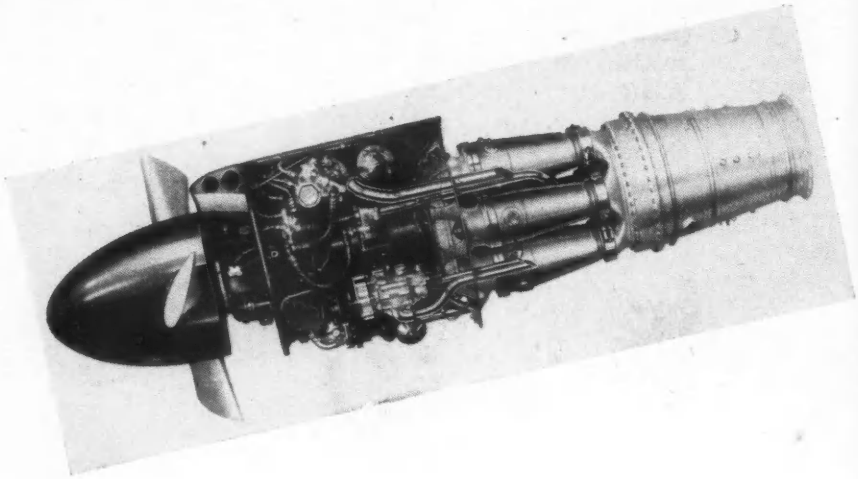


The three rotor blades of this SO-1100 autogyro are jet driven by compressed air and are used for hovering. At the rear is the enclosed pusher propeller which is driven by a radial aircooled engine. (Acme photo)



(Left) French 24 cylinder fuel-injection Hispano-Suiza. Its output is 3600 hp at 2800 rpm

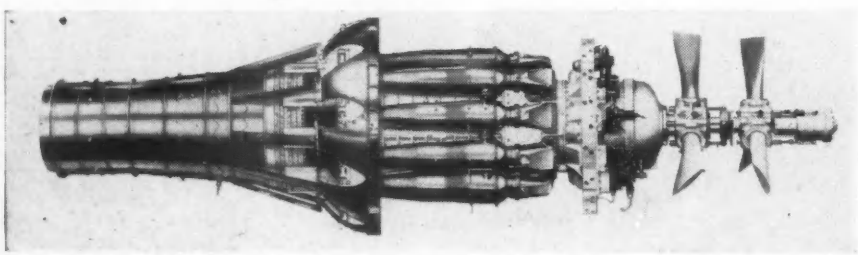
(Below) Armstrong Siddeley Mamba turbine engine develops 1010 shp and 370 lb thrust at sea level takeoff. Weight is 750 lb, about 75 per cent of an equivalent piston engine

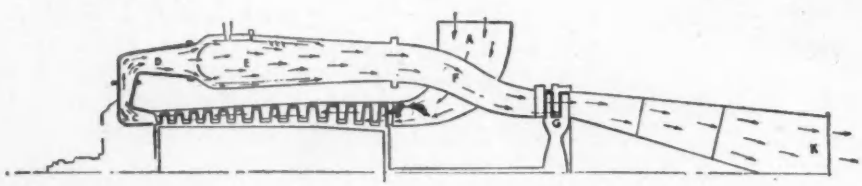


ing the former Lorraine-Dietrich works at Argenteuil, Gnome & Rhone, with three big factories in Paris and suburbs, and Renault on the edge of Paris. The aircraft firms which have maintained their independence are Breguet and Morane-Saulnier. Among the engine makers, Hispano-Suiza, Potez, Mathis, Rateau, and Train have been left independent. All the equipment manufacturers are independent. It is estimated that there are 75,000 workers in the French national factories. In addition to these, the State arsenals at Chatillon, Bordeaux, Clermont-Ferrand and Maison Blanche (Algeria) have important aviation (engine and plane) sections. Between 1935 and 1940 every effort was made to decentralize the French industry. Now there is a movement to group all the technical services in and around Paris, where the Ministry of Armament is located, and to leave the production in the provinces. Already there are important laboratories and technical services at Chalais-Meudon, St. Cyr, and at the Hispano-Suiza factory at Bois-Colombes.

No hall is big enough for a modern aviation exhibition and in the Grand Palais all large aircraft were shown as models, generally only the medium and private planes being complete. Because of postwar conditions, the French independent makers have specialized on private one to four-passenger planes, of which at least 12 different types are displayed. A good example is the Courlis, manufactured by Chausson, the leading French sheet metal firm. This is a high wing pusher monoplane with fixed tricycle undercarriage. Sheet steel with electric welding is used for the fuselage and the twin booms are also of sheet steel, following general automobile lines of construction. It is one of the best attempts to get into big production, with consequent price reduction.

A few months ago a competition was held for private planes, and the four winners are shown. They are the Nord 1200, Morane 570, the Max Holste and the





Armstrong Siddeley python gas turbine which has a sea level static rating of 3670 shp and 1150 lb thrust at 8000 rpm. Drawing shows general layout of air intake, compressor, combustion chambers, turbine and exhaust duct

Engineering Library

S. E. 2310. All of them are of the same general type, with maximum speeds of 130 to 150 mph.

Big French commercial planes are mostly in the experimental stage. The biggest in the show was the Cormorant freighter, the fuselage of which occupied the full width of the hall and was rendered more impressive by having an 8-ton Berliet truck within it. It has a span of 144 ft, height of fuselage 18 ft and total load capacity 37,450 lb. Fitted as a passenger plane, the machine will carry 131 to 150 people. Engines are four 14R radials (Gnome & Rhone).

Breguet's 40 tonner was shown in model form. It is a midwing monoplane with a double deck fuselage, designed to be powered by four Gnome & Rhone 14R engines of 1600-1700 hp or four Bristol Hercules. The entire rear bottom portion of the fuselage is hinged to permit loading by a ramp. The interior volume available for useful load measures 49 ft with a width of 9 ft. As a passenger plane, the upper deck carries 55 seats in three compartments—two of 15 forward and one of 25 at the rear, and on the lower deck 46 passengers, also in three cabins. Total is nearly 84,000 lb and pay load 39,000 lb.

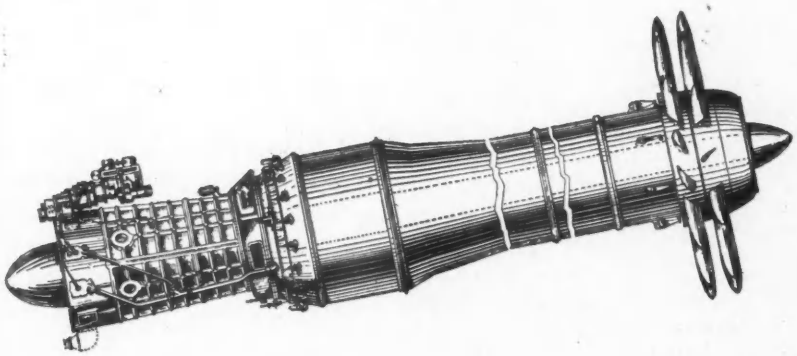
French officials claim that by the end of 1946 two Latecoère 631 flying boats will be in operation on the French West Indies route, and a third one at the beginning of 1947. A high wing monoplane with a span of 188 ft 6 in. and a length of 142 ft, it is designed for 45 sleeping berths, while carrying a crew of nine, and will have a cruising speed of 200 mph with a range of 3700 miles. The first three ships will have six Wright 14A-5B engines, later models having the Wright 14 BB. Weights will be 72 and 75 tons for the respective models.

In the British section there were a number of models of big capacity passenger planes, most of which are at present under construction. In addition to a model of the Bristol 167 Atlantic air liner, this firm had also an elaborate scale model of the new airdrome and assembly hall being built at Bristol. The 167 which will be in service next year, it was announced, has a span of 230 ft, with a length of 177 ft, and the handsome cut-away model shows it equipped with eight Centaurus engines, which later will be replaced by turbines.

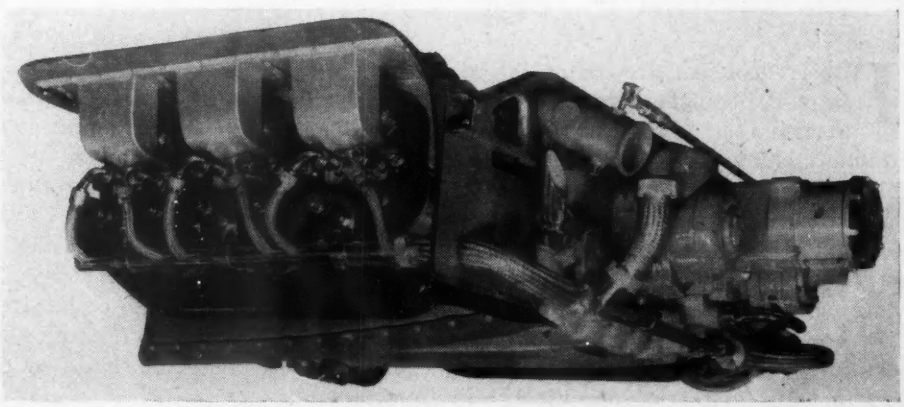
Not much information was available regarding the Saunders-Roe SR/45 100 passenger flying boat, shown in model form. It has a span of 220 ft, a length of 145 ft and an approximate gross wt of 290,000 lb. The make of the six gas turbines was not specified, but it is assumed that they will be Metropolitan-Vickers. This jet propulsion engine, F 2/4 model, is at the present time being fitted in the Saunders-Roe fighter flying boat. By reason of its small 37.25 in. diam, two engines can be fitted side by side in the hull. All the air is taken in through the bow of the boat and discharged just behind the trailing edge of each wing.

Shut off from all intercourse with the outside world, it is not surprising that the French industry has not got beyond the experimental stage in jet and turbine engine. Hispano-Suiza has taken up the license for the construction of the Rolls-Royce Nene, and shows a model on its stand. Working in secret during the occupation, the Rateau Company developed the SRA model, which has an axial compressor with four low-pressure stages and twelve high pressure wheels. The nine combustion chambers are grouped around the compressor casing and are of the reversed flow type feeding into the two-stage turbine. Still under development, this engine is stated to give a sea-level thrust of 1760 lb at 7500 rpm or, with the after burning device obtained by by-passing some of the air from the low stages of the compressor to

(*Turn to page* 67, *please*)



(Above) Metropolitan-Vichers F5 with open fan augmentor. This augmentor unit is mounted behind the trailing edge of the wing and adds a fixed-pitch propeller to the jet engine. Better specific fuel consumption is claimed over a wide range of flight speeds



(Right) Fedden aircooled flat six designed for light twin-engined planes can be fitted inside a 14 in. thick wing. It has single sleeve valves

Engineering Library

Cleaning aluminum housings for motors used in airplanes is simplified with this basket and electric motor lift arrangement at the Rheem Manufacturing Co., South Gate, Calif.

Aluminum Cleaning Must Be Engineered

By Don Vance
Chief Chemist
Kelite Products, Inc.

THE tremendous growth of the aircraft industry from 1939 to the present has served to acquaint thousands of manufacturers with the use of aluminum. Although in the beginning it was chosen chiefly for its weight advantages, it later disclosed still further virtues when subjected to stress, corrosion and oxidation tests. It quickly established its versatility from a fabrication standpoint, also, in casting, shearing, forming, deep drawing and machining.

Recent events have brought aluminum still more forcefully into competition with steel and other alloys. But in some instances, manufacturers familiar only with processing and fabrication of steel and other ferrous metals were brought up sharply with the realization that along with its virtues, aluminum also possessed a few inherent characteristics which presented manufacturing disadvantages.

One of the chief of these disadvantages is due to the crystalline structure of the metal itself, its porosity, which in turn means cleaning difficulties. The porous surface contains soil of many kinds which is imbedded during the process of manufacture, such as from drop hammers, rollers and heat treating. This soil or foreign matter is particularly stubborn and necessitates special types of cleaning compounds. Other types of cleaning difficulties are caused by grease and oils, paints and dyes.

Owing to the fact that most aluminum assemblies are either spot-welded or seam welded, it is necessary to consider the cleanliness of the metal in terms of surface resistance. With electro-welding processes the importance of uniform cleanliness and the resultant uniformity of surface resistance cannot be too strongly emphasized. Ordinarily, spotwelding and seam welding are relatively simple operations and require attention to only a few details. But if the equipment is adjusted to a certain resistance and then encounters varying resistances, troublesome and costly interruptions result. In addition to the time lost in making readjustments, the life of the electrodes is shortened by the frequent cleaning. Burning, spitting and uneven welds caused by the variable surface resistance are also responsible for many rejected parts and assemblies. It is now definitely established that the cleaning required to obviate the electro-welding difficulties must follow a special procedure. The ordinary methods used for other metals are not practical for many reasons. In the first place the common use of an alkaline treatment to combat acid deposits is not permissible unless the alkaline compound is buffered to prevent attack on aluminum.

A specially trained chemical service engineer sets up a complete cleaning process based on an analysis of the soil encountered. By "soil" is meant all forms of foreign matter on or in the metal surface such as dirt, grease and oil, gummy or carbonized oil, stamping ink or dyes used for identification marks. The analysis is made on the basis of pH, a measurement of acidity or alkalinity of a substance. By such a measurement the service engineer can chart a very definite course in the cleaning process, for instance, the use of an alkaline compound to combat acid deposits and the use of an acid to combat alkaline scale.

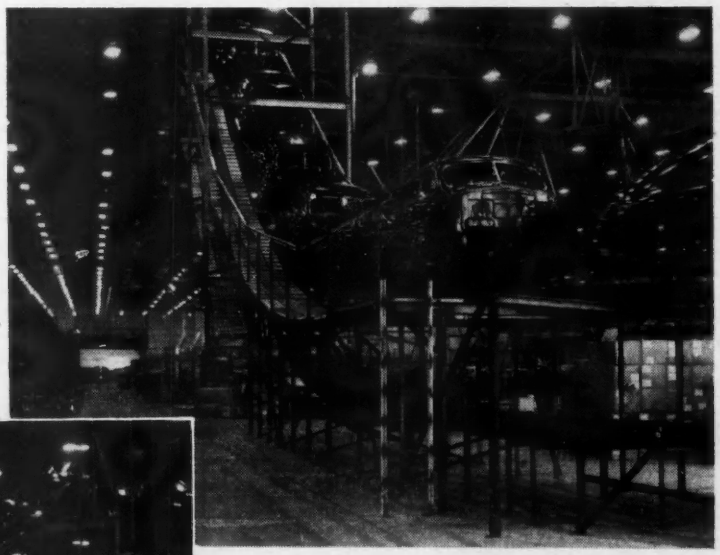
In starting the cleaning operation it is well to bear in mind that the different chemical solutions employed must be engineered to remove the stubborn soils instead of being built for the easy ones. It is not enough to just take care of the average deposits. It has been

(*Turn to page* 82, *please*)

Body Conveyor *at New BOP Plant*

Suspended from Ceiling

(Top of page) The Buick-Oldsmobile-Pontiac assembly plant of General Motors at Kansas City, Kansas, a blackout plant built during the war for the assembly of B-25 bombers, is equipped with nearly 42,000 ft of conveyors. The building, with its 1,600,000 ft of floor space, is air conditioned and has fluorescent illumination. Present production plans provide for increasing the number of employes from 2000 at present to between 2500 and 3000. This view shows the final assembly lines at the plant



(Above) The body conveyor at the BOP plant is 1315 ft in length and suspended from the ceiling, nearly 40 ft above the floor. The entire system will accommodate over 1000 bodies at a time

(Left) Bodies come down on the conveyor to the floor where they are picked up by the body drop

Unique Tooling *Used to*

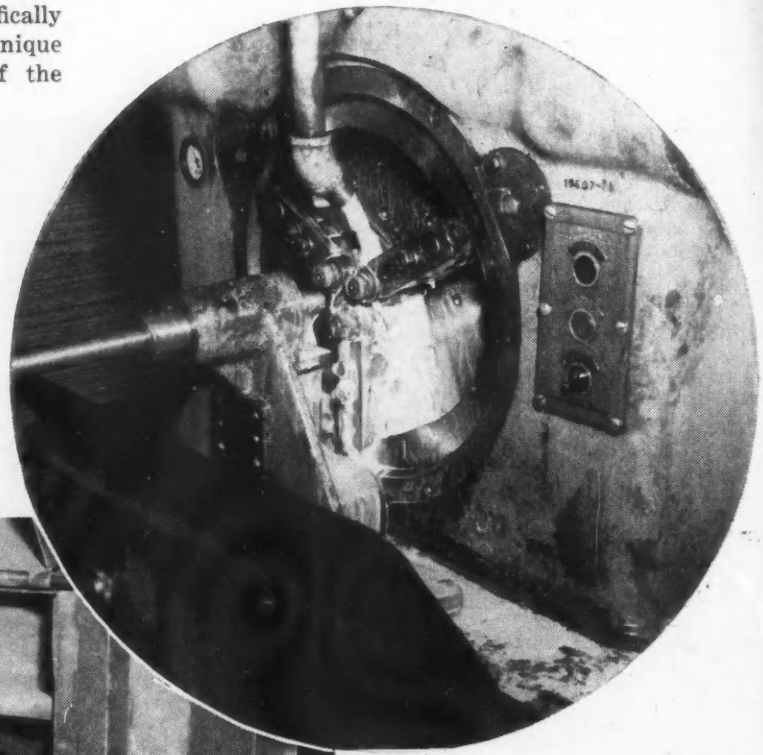
ALTHOUGH recognized as one of the leading producers of steering gears for passenger cars and heavy duty vehicles, the Saginaw Steering Division, General Motors Corp., has not been as well known as a supplier of a variety of special parts—many of them requiring unique precision methods—which are produced for other divisions of GMC and other manufacturers. This accounts for the operation of two major plants—Plant 1 and Plant 2—in Saginaw, Mich. Plant 1 is a machine shop of advanced type, provided with specialized and flexible equipment, and tooled for the manufacture of a wide variety of parts; Plant 2, on the other hand, is devoted exclusively to the manufacture of steering gears.

Both plants boast manufacturing equipment of the latest type, feature modern mass production methods and, in addition to machinery of comparatively recent origin, have certain machine tools designed specifically for the company. Some of the machinery is so unique that it has no counterpart in other plants of the industry.

Taken as a whole, Saginaw produces steering gears, steering gear linkages, propeller shaft assemblies, universal joints, transmission parts, precision bushings for front end suspensions, cam followers, valve guides and pumps for Diesel engines, and other specialized items. Latest important venture is the manufacturing setup for making the Saginaw bumper jack, featuring the recirculating ball-type screw which is an adaptation of the principle used in the steering gear.

It may be noted further that each of the plants is a self-sufficient unit with a full complement of machine tools, heat treating, plating, and the other facilities essential to a well rounded operation. Considering

This is the 125th in the series of monthly production features

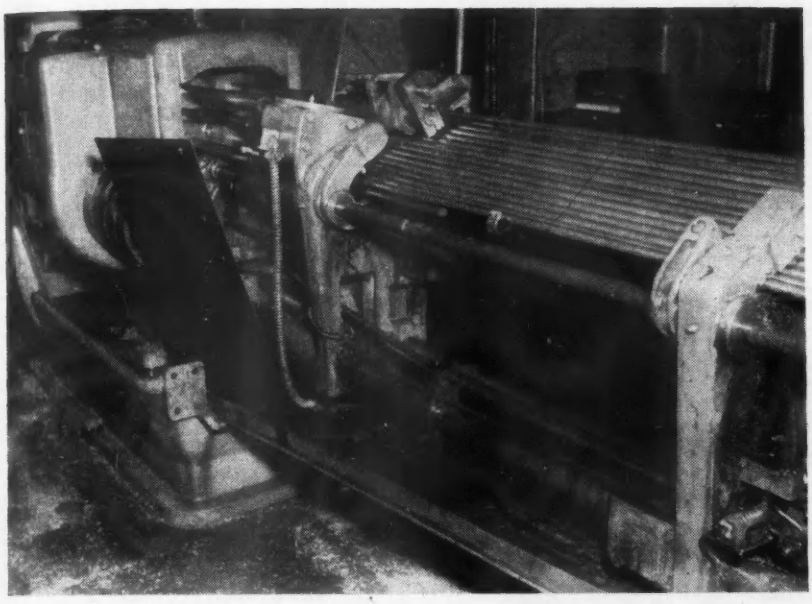


Circle:
Workhead of the Model TR National Acme thread rolling machine which is used for rolling the thread on the body of the jack screw.

Left:
Close-up of Federal resistance welder for butt-welding the steering worm to the shaft.

Mass Produce Special Parts at

GMC Saginaw Steering Plants



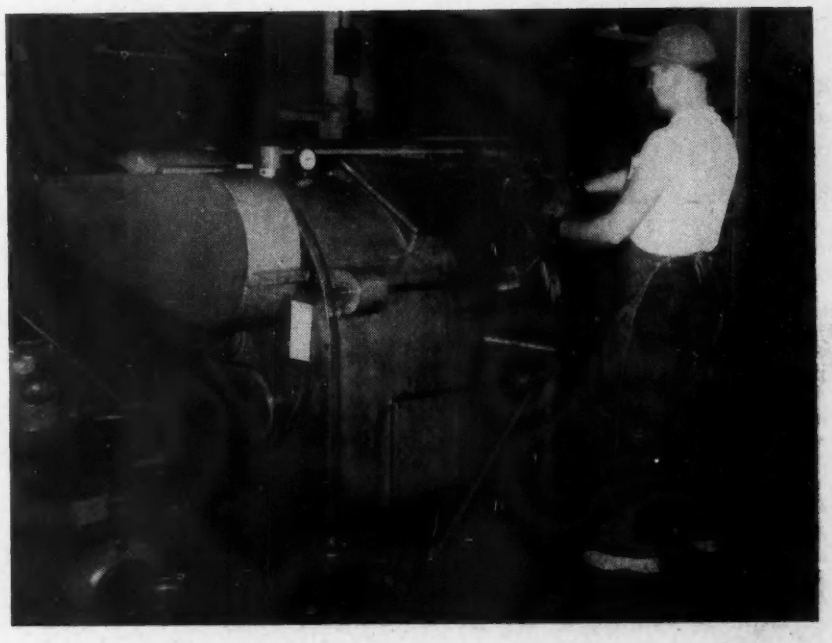
Greenlee bar automatic with the special magazine feed described in the text is used for machining the end of the steering gear shaft.

By Joseph Geschelin

the size of these plants and the amount of metal removal that is done, it is noteworthy that the surface broaching technique has practically eliminated the usual milling machine operation one would expect to find. Both plants feature large batteries of the latest type vertical surface broaching machines of twin ram type made by Cincinnati, OilGear, and LaPointe. Hole broaching, of course, is done on large vertical broaching machines. While special machines will be described more fully in covering the fabrication of selected parts, it is of interest to mention a few at this point. The long jack screw, for example, has the screw thread produced by thread rolling in a National Acme machine. Sector teeth are rough cut in large vertical Cincinnati Duplex Hydro-Broach machines, then are finish-cut to precise limits on a battery of special Fellows gear shapers of horizontal rack type.

Among the exceptional features claimed for these gear shapers are high productivity and simplicity and relatively low cost of tooling. The cutters used on this equipment cost considerably less than those for the conventional Fellows machines used on other operations in this plant, according to the management.

Versatility of the basic Barber-Colman hobbing machine has been exploited to an unusual extent by Saginaw. A group of the familiar Type D heavy-duty hydraulic hobbers has been tooled to serve as thread millers for cutting the worm thread.



View of one of the Baird double-end, double-indexing automatics for hollow-milling, drilling, chamfering, and facing the spider journals.

Later, this thread is finish-ground in Jones & Lamson precision thread grinders. Latest trick is to cut the internal thread in the worm nut on Barber-Colman hobbers fitted for internal thread milling, using a special outboard mounting to provide rigid support for the milling hob. Too, there is a special Greenlee automatic tooled for machining the ends of steering gear shafts. Feature of this machine is a unique inclined magazine which is loaded by the operator. Then the lower shaft is picked up by a roller mechanism, rolled down into position for feeding, and pushed automatically into the collets.

Cemented carbide cutting tools are used for turning and boring operations on steel while cast hard metal composition tools are used on Bullard Mult-Au-Matic machining of malleable iron housings.

Each of the plants is completely mechanized with monorail conveyors, gravity roller conveyors, and other forms of materials handling devices suited to the specific job.

To simplify the visualization of this operation, we shall take each plant at a time and provide a mental picture of what goes on by covering the manufacturing procedure for a selected group of parts.

Motion economy through motion study is one of the important activities in both plants. Fruits of this work are found in the layout of work benches and assembly stations, and in the design of work-fixtures. The assembly of small parts has been greatly facilitated by this technique of arranging the work place and bins of small parts within each reach of the operator and in the sequence required for the job at hand.

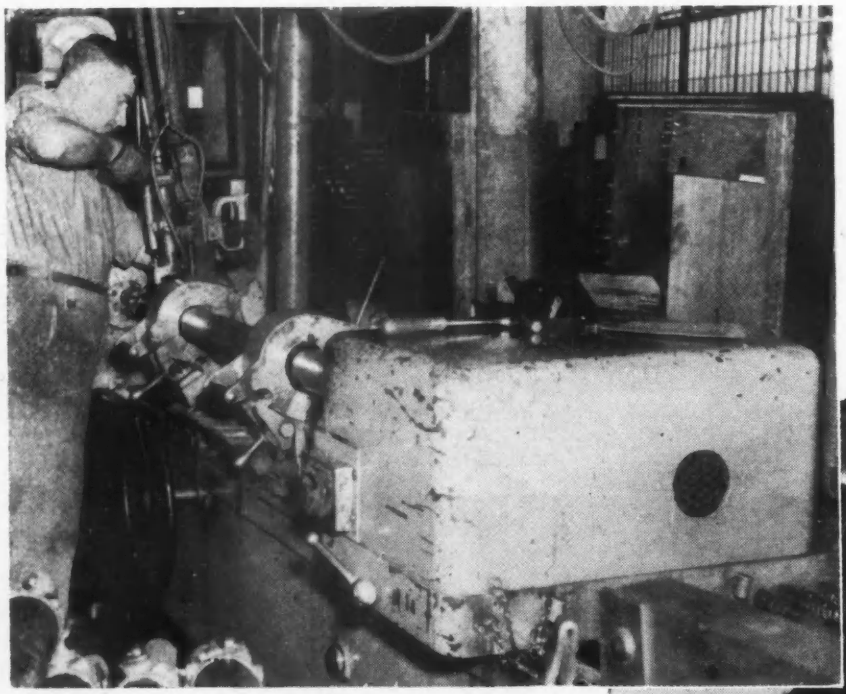
Plant One

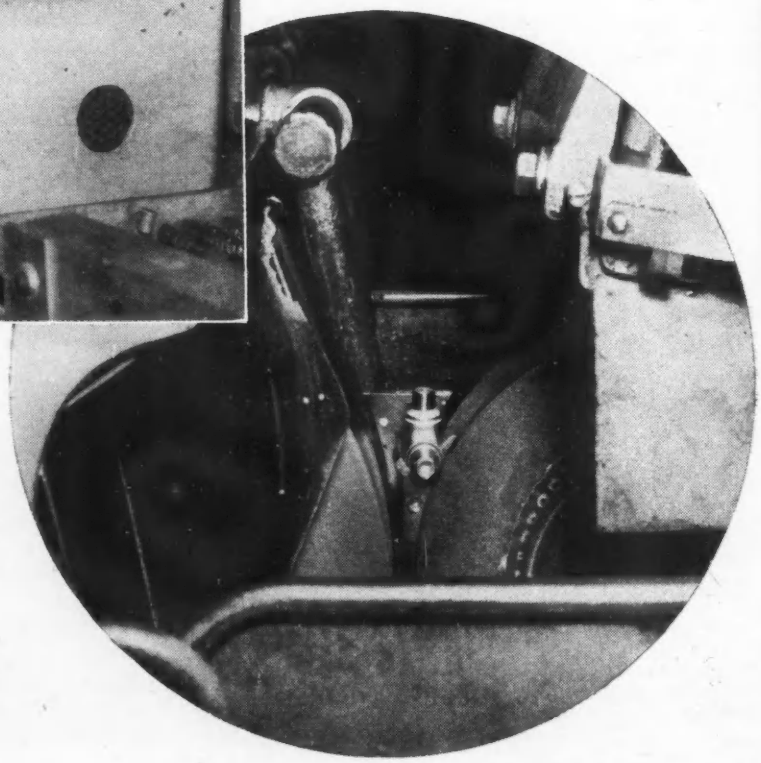
Plant 1 has an excellent automatic screw machine department replete with large Conomatics, National Acme Gridleys, and a battery of new New Britain-Gridley six-spindle automatics. For a sampling of the activity in this plant we shall consider the manufacture of the jack screw, universal joint spider, and clutch ring.

Jack Screw

The jack screw starts in the form of bar stock of GM X-1325 steel, about ½ in. in diameter and 32 in. in length. First operation is in a No. 2 Cincinnati Centerless grinder in which the OD is finished to 0.4668/0.4678 in. The machine is equipped with automatic hopper feed and a cemented-carbide tipped thrufeed work rest blade. Next is the broaching of the tongue at one end—holding length to 0.880/0.8875 in. and width to 0.375/0.380 in. This is done in a vertical XD 12 by 24 OilGear surface broaching machine, using Detroit Broach tools.

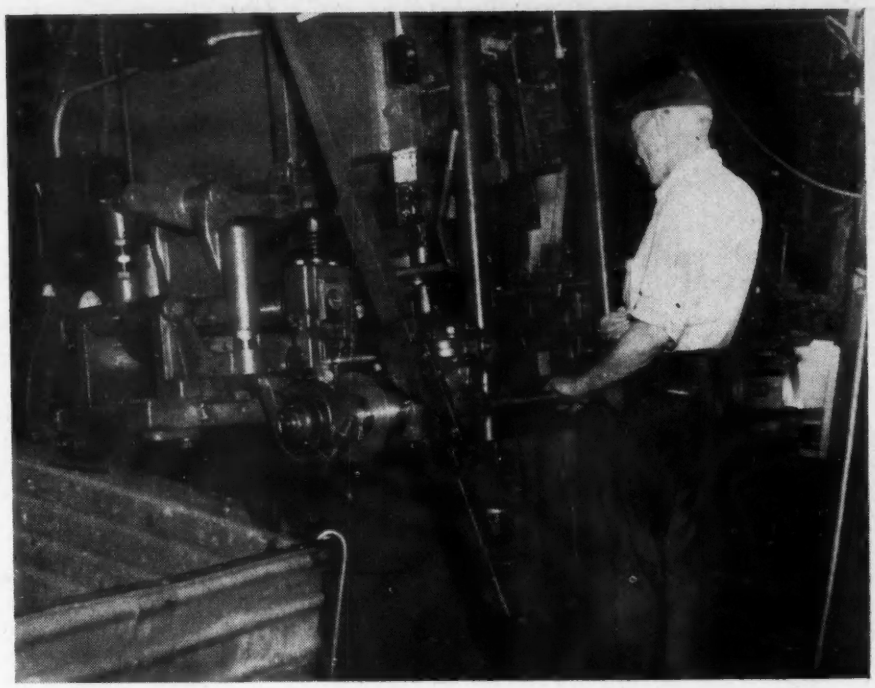
The shafts now go to the new Britain Gridley six-spindle chuck-





Above:
One of the new GMR machines for balancing propeller shaft assemblies to ½ oz-in. Weights or slugs to give required balance are welded onto the part by means of a portable Progressive Welder gun which may be seen in use by the operator at the extreme left.

Circle:
Looking into the No. 2 Cincinnati Centerless grinder tooled for finish-grinding of universal joint spider journals. The arrangement for holding the work may be seen here. Grinding is done in two settings to complete the finishing of two pairs of journals.



Blanks for spring steel clutch plates are produced in this Verson All-steel press fitted with a motorized Wittek reel and pulled through the die with an automatic feed mechanism at the left.

ing machines for turning, chamfering, and cutting the thread, and cutting a groove on the end previously broached. The thread is now rolled for the entire length of the body in a Model TR National Acme Thread Rolling Machine, using three rolling dies. This is a very fast operation, the job being done at the rate of three feet per min, and is held to extremely close tolerances—lead error not to exceed plus or minus 0.003 in. per in. of thread. The length of the screw naturally increases due to the cold rolling operation, the final length being 32 5/16 in., plus or minus ⅛ in., or an increase of around 7/16 in. maximum.

The shaft now is ready for heat treatment and plating preceding final assembly. The first operation is to harden in a liquid salt bath, then quench in a special roll-quenching machine developed by Saginaw. Next is order are: electrolytic clean, cold water rinse, cold 50 per cent hydrochloric acid dip, cold water rinse, zinc plate in Meaker unit, cold water rinse, hot water rinse, and draw at 300 F. The screw then is inspected and transported to the assembly department.

Universal Spider

The universal joint cross journal or spider forging has the four journals hollow-milled, drilled, chamfered, and faced in a new Baird automatic, double-end, 12-station, double-indexing machine illustrated here. The first position spot-drills at 458 rpm and 0.005 in. feed; second position rough-turns with National Acme milling heads at 458 rpm and 0.016 in. feed; third position, finish-turn; fourth position, center drill; fifth position, drill at 1340 rpm and 0.003 in. feed. This sequence completes one pair of journals and is repeated for the other pair.

The parts are washed in a Blakeslee washer, carburized in a Homo-Carb furnace and quenched, drawn in an Industrial Heating furnace. The parts then are Rockwell tested to assure proper hardness, and sandblasted in a No. 2 Pangborn machine.

One of the most interesting operations is the finish-grinding of journals in a No. 2 Cincinnati Centerless grinder, equipped with a work lowering fixture so designed as to permit the operator to lower the work into position and then raise it for indexing the other pair of journals as well as to facilitate removal of the part. So far as the operator is concerned this simply means raising and lowering a lever. Diameter of the journal is held to 0.5272/0.5282 in. Following this operation, the ends are ground to length in a No. 230 Hanchett Badger grinder, holding length to 2.874/2.875 in. Moreover, the maximum deviation from the center to the end on each side is held to 0.005 in.

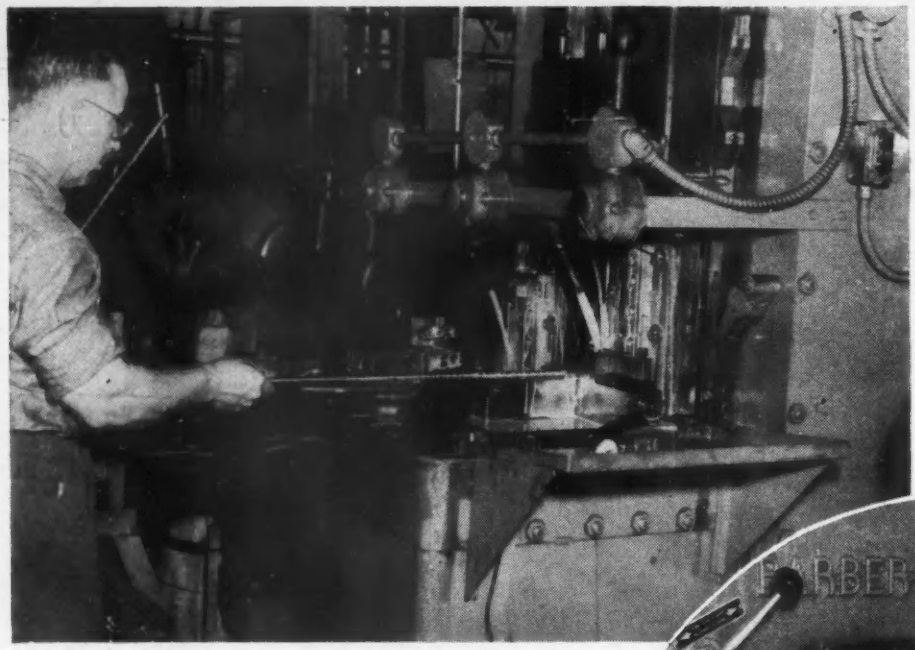
Noteworthy operation on propeller shaft assemblies is the final balance which is taken at extremely high speed in a GMR machine of recent design. A feature of this machine is the use of a portable Progressive welder gun for welding on a small slug of the exact weight and in the location required to provide complete balance within ½ oz. in.

Another interesting spot is concerned with the fabrication of clutch plates made of spring steel stock. The blank for this part is produced in a Verson all-steel press from strip in coil form, fed from a motorized Wittek reel, and pulled through the die with an automatic feed mechanism. The blank is formed and pierced in two adjacent Bliss presses. Following these operations the plate is heated and quenched. Heating is handled in two large HPM presses of platen type, each one having a stack of five electrically-heated dies. At the end of the heating cycle the plates are oil-quenched.

A five-head Allen drill setup is used for the threading of bushings for front end suspensions. Each of the heads has two spindles, the finished work being removed on a small mechanized conveyor built into the table. The job is to produce a qualified internal and external thread in the same setting and to hold concentricity within plus or minus 0.003 in. To this end, each spindle is provided with a die head for the external thread and a tap for the internal thread, the tap being piloted through the die head. It is a noteworthy example of improvisation in which a relatively standard machine does a special-purpose job requiring unusual precision.

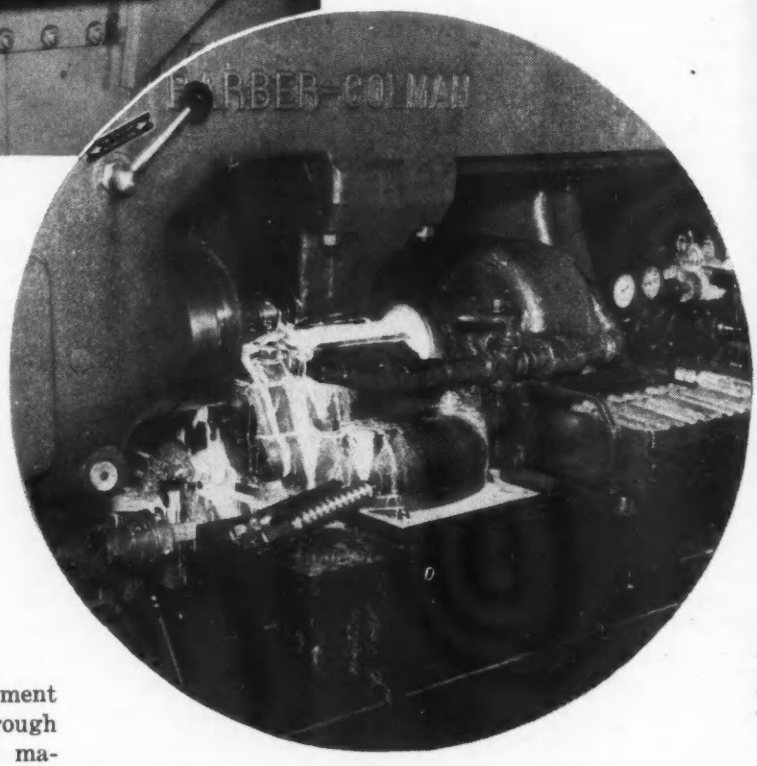
Plant 2

Specializing in steering gear assemblies exclusively,



Left:
Close-up of XD OilGear surface broaching machine for cutting the tongue and slot on the end of the jack screw.

Circle:
The ball race thread in the steering worm is cut in the Type D Barber-Colman hobbing machine, to give the effect of thread milling, using a standard hob but with the cutting axis parallel to the axis of the work.



Plant 2 currently produces about 16 different models made in three distinct types—worm and sector type, roller tooth type, and recirculating ball type. Facilities are designed primarily for volume production, using machinery of the most advanced type, and served by a monorail conveyor system running some 1200 feet for transporting parts into and out of washing machines and feeding the assembly lines.

Outstanding of the departments in this plant is an enormous bay of automatics running the full length of the building. Among the basic items of equipment will be found Conomatics, National Acme-Gridleys, and New Britain-Gridleys. This arrangement permits the routing of all first operation jobs through the automatics and then out into the adjacent machine shop lines for the succeeding steps. So far as feasible, the first operation is scheduled on machines nearest to the second operation departments to reduce handling and to step up productivity.

To simplify the problem of visualizing what goes on here we have selected one of the large volume recirculating ball type assemblies for study. Analysis of the sequence of operations on a few of the major parts of this gear will give the reader a good impression of the facilities.

Pitman Shaft Gear

Consider first the Pitman shaft gear, a steel forging. The first operation is broaching to length in a Foote-Burt horizontal surface broaching machine fitted with a continuous conveyor and two sets of Detroit Broach tools. Length is held to 8.276/8.286 in., the cutting being done at the fast rate of 45 fpm. The shaft is centered at both ends in a Lo-Swing centering machine with a spindle speed of 1000 rpm and feed of 0.005 in. A 12 by 22 Sundstrand automatic lathe does the rough-turning of the long end, and finish-turning of the thread diameter and taper. The tooling for this setup comprises a set of six tools for the front and five tools for the back slide. Another setup on the same type machine does the turning of the short end, and chamfering and finish-turning of the long end, using three tools for the front and rear slides.

Rough-grinding of the end is handled in a No. 2 Cincinnati Centerless grinder, followed by the rough-broaching of sector teeth in a large vertical No. 10-66 Cincinnati Duplex Hydro-Broach cutting at the rate of 30 fpm. Finish-cutting of the five gear teeth has been speeded by the introduction of a battery of unique horizontal rack type gear shapers developed by Fellows for Saginaw, claimed to be the only ones of their kind to be found in the industry. Pitch line of the teeth is inclined to the longitudinal axis at an angle of 6 deg 19 min.

The arm end is serrated on a Type A Barber-Colman hobber, cutting 32 serrations on the taper surface. Next follows the broaching of a Tee-shaped slot in the short end of the shaft in a vertical No. 5-54 Cin-

cinnati Duplex Hydro-Broach fitted with an automatic indexing fixture on the work table. This operation is performed in two stages at the rate of 30 fpm.

Having completed the basic "green" operations, the shaft is ready for heat treatment and finish-grinding. The work is degreased in a Detrex solvent degreasing machine, copper plated at the arm and for masking, carburized and quenched, drawn, then sand-blasted. Copper plating in the Meaker unit takes about an hour to produce a minimum coating of 0.0005 in.

Both ends are annealed in a Selas flame heating unit and deburred at the Tee-slot. The arm end is threaded in a single-spindle Landis threading machine fitted with a Lanco die head at a spindle speed of 150 rpm. This is followed by finish-grinding of the short end and semi-finish grinding of the long end in No. 2 Cincinnati Centerless grinders with double wheels supplied by Mid-West. These grinders are fitted with elevating-lowering cradles to facilitate the loading and unloading of work. The long end is finish-ground in another No. 2 Cincinnati Centerless grinder with a Mid-West wheel having a concave surface on one side so as to finish the fillet and shoulder at the sector section.

Ball Nut

The ball nut, the heart of the recirculating ball mechanism of the gear, makes an interesting study of process. Work starts in the form of rectangular bar stock of 1¾ by 2 1/32 in.—GM 5120-A hot rolled steel with rounded corners—presented to a battery of large 3½ in., six-spindle Conomatics fitted with rectangular collets. The first four stations progressively drill to depth, the fifth position does the counterbore and facing, the sixth position cuts off to length. The work then is washed, sand-blasted, and copper-plated. Next major operation is the rough-broaching of rack teeth in a No. 20-66 OilGear Vertical surface broaching machine of twin ram type with an indexing fixture, cutting at the rate of 25 fpm.

A series of drilling, reaming, and related operations now takes place in a heavy duty Baker semi-automatic drill fitted with a 12-station Buhr head. The second, third, and fourth stations drill four holes for the recirculating ball tubes; the fifth, sixth, and seventh stations countersink; the eighth, ninth, and tenth stations face the bottom of the drilled holes; the eleventh station drills three holes. Boring of the center hole and countersinking of the ends is done in a National Acme-Gridley six-spindle chucking machine with a spindle speed of 302 rpm and feed of 0.015 in.

The internal thread grove for the recirculating balls, having a lead of 0.4130 in., is thread-milled—an unusual operation—in a Barber-Colman hobbing machine set up for thread milling. For this purpose, they use a hobbing tool supported at the outer end by an outboard adaptor to assure rigidity and accuracy. The return tube holes are reamed and deburred in a three-spindle Allen drill press with a five-spindle head. After the three small holes are tapped in a Haskins taper the nuts are ready for heat treatment. They are degreased in the Detrex machine, carburized, quenched, and drawn, then sandblasted. The final major operation is the precision grinding of the thread groove in Ex-Cell-O internal precision grinders.

Steering Worm

The steering worm also features many interesting and unusual operations. The job starts with bar stock, 1 5/32 in. diameter, GM 5120-A hot rolled steel, the part being rough turned and cut off in a 1⅝ in., six-spindle National Acme-Gridley automatic. The OD of the thread groove and shank, stepped diameters, is ground in a No. 2 Cincinnati Centerless grinder fitted with two Mid-West wheels. The steering worm has cone shoulders on each end of the worm section and these are shaved to form in a Sundstrand Type E automatic Stub lathe, using special forming tools. The ball race thread then is cut in a Type D Barber-Colman hobbing machine, using a standard hob but with the box axis parallel to the work to produce the effect of thread milling.

The work is degreased, copper-plated at the shank end, carburized and quenched, drawn, and sand-blasted. The OD over the threaded section is ground

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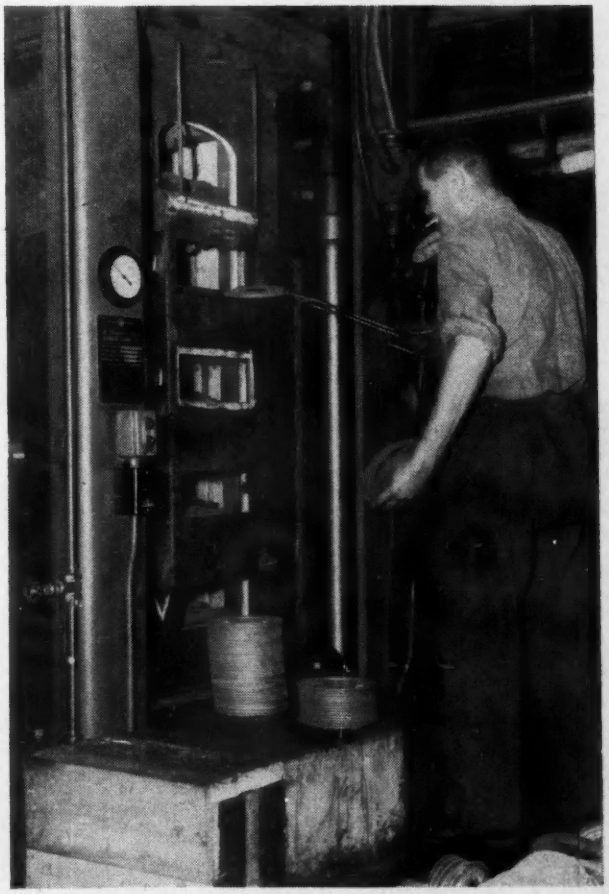
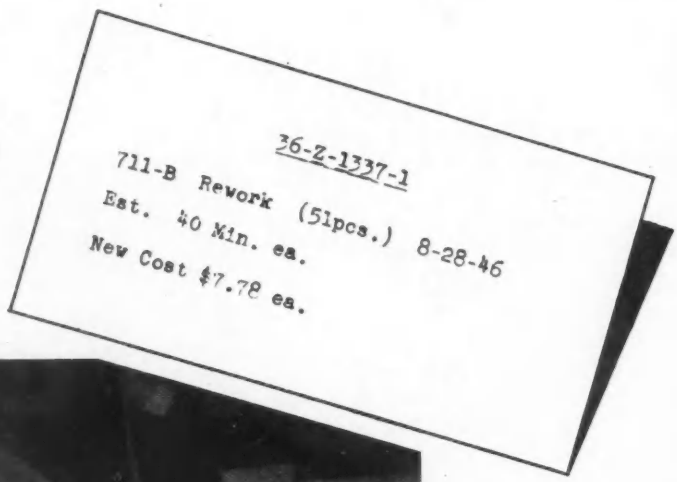


Close-up of one of the large H-P-M hydraulic presses of platen type for heating of clutch plates. Each of these presses has five electrically heated dies, the operation being performed under pressure and at a standard temperature. Quenching is done in a tank on the right.

Ford Reorganizes Salvage

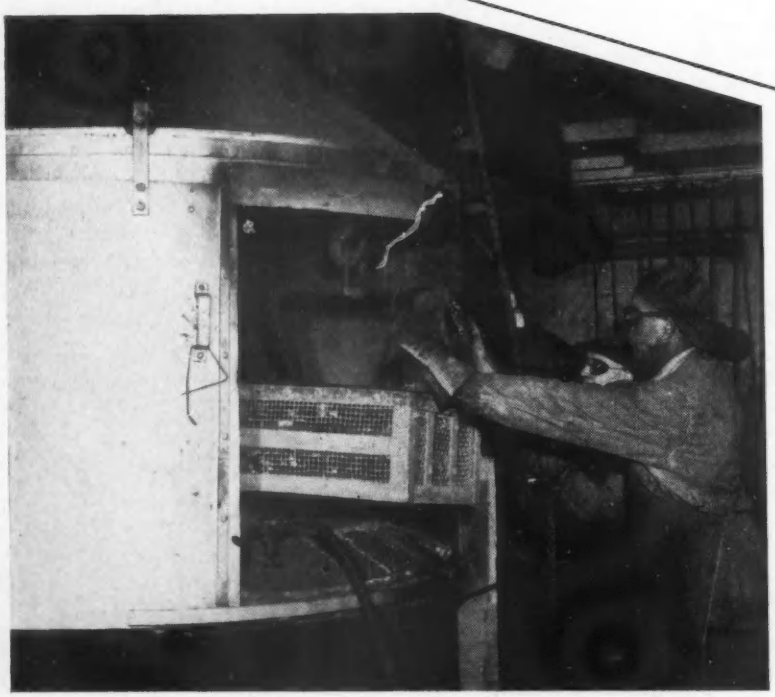
THE present hectic and highly unusual conditions prevailing in the automotive industry would appear upon superficial inspection to have led to complete abandonment of the traditional cost consciousness. Recent reports of expensive stop-gap measures resorted to by various manufacturers—such as air express shipments, use of expensive substitute materials, and similar measures—give a common impression that cost is of minor importance. Actually, the reverse is true. The pressure of high costs for both unusual and ordinary functions against ceiling prices and the little or no profit margin at curtailed levels of production has led to a greater need than ever before to pare down production expense in every possible way. Current high wage rates and the prospect of possible future increases, the continuing low productivity of labor, and high operating expenses in general, call for careful scrutiny of the cost structure, if anything like reasonable profits are to be realized, and automobile prices, now considered dangerously high for a large potential market, are eventually to be reduced.

Under its new and aggressive leadership, the Ford Motor Co. already has completed a thorough job of overhauling one of its non-productive departments. The Ford salvage department has long been recognized as one of the most highly organized in the industry. However, in view of the changed conditions prevailing today, it has been necessary to re-examine every operation critically from a cost basis. As a result, some salvage jobs have been found to be no longer profitable and have been abandoned. One of the reasons some operations have been discontinued is that the cost of labor has risen so high in recent years that it is disproportionate to the savings effected by the particular salvage operation. In short, the one standard which every segment of the salvage department must meet is that the job must stand on its own feet financially. The company figures that it has cut its salvage cost 50 per cent under the reorganized setup.



Form of card used in Ford salvage department showing part number, number of minutes necessary for rework and new cost. Part No. 36-Z-1337-1 refers to a three-step drill. No. 711-B indicates that the drill is from the tool and die department.

Another change that is taking place in the salvage department is a new concept of its functions. Formerly, materials to be salvaged were handled by the department either for reclaiming or for disposal. The idea now is to make the department largely a brokerage office which will direct the flow of scrap material, with the actual physical handling being done by the department where the scrap originates. Under the present sys-

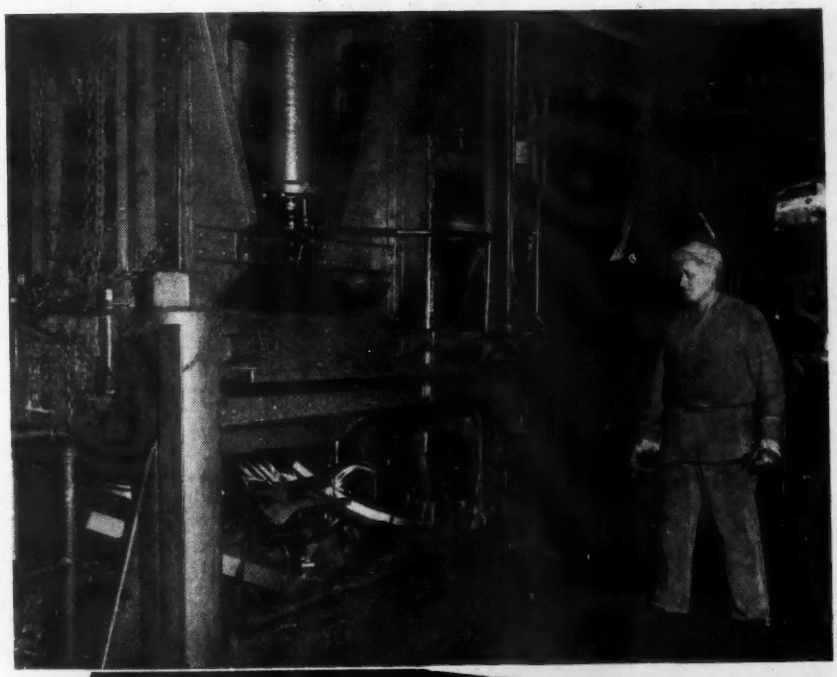


Lead in large quantities is salvaged by melting old battery plates, cables and hundreds of other items. In this photo Ford workmen are placing a tray of babbitt bearings into a melting furnace at the Rouge plant.

By Leonard Westrate

Department

Due to Changed Conditions



From 250 to 300 tons of steel clippings and scrap are salvaged daily at the Rouge plant. This huge press is used to press scrap steel for remelting.

tem, when any material becomes surplus to any particular department, Salvage is notified. The first objective is to find out if any other department can use it. If not, the material is classified either as of possible future use, in which case it is stored, or of no value and turned over to the by-products division for sale.

Reclaiming activities will still be carried on in the salvage department. The department has worked out a cost estimate system to determine whether any particular reclaiming operation is a paying proposition. With the department's per-minute operating cost determined, an estimate of the time required is made and the repair cost is the result obtained by multiplying these two factors. This is balanced against the known new replacement cost, and if as great or greater, the job is thrown out. A card index file has been established showing each reclaiming operation, the time required, repair cost, and new replacement cost. There is, of course, one exception to the rule that each job must pay out. In case of a breakdown which stops assembly, tools are repaired without regard to cost, since down-time loss

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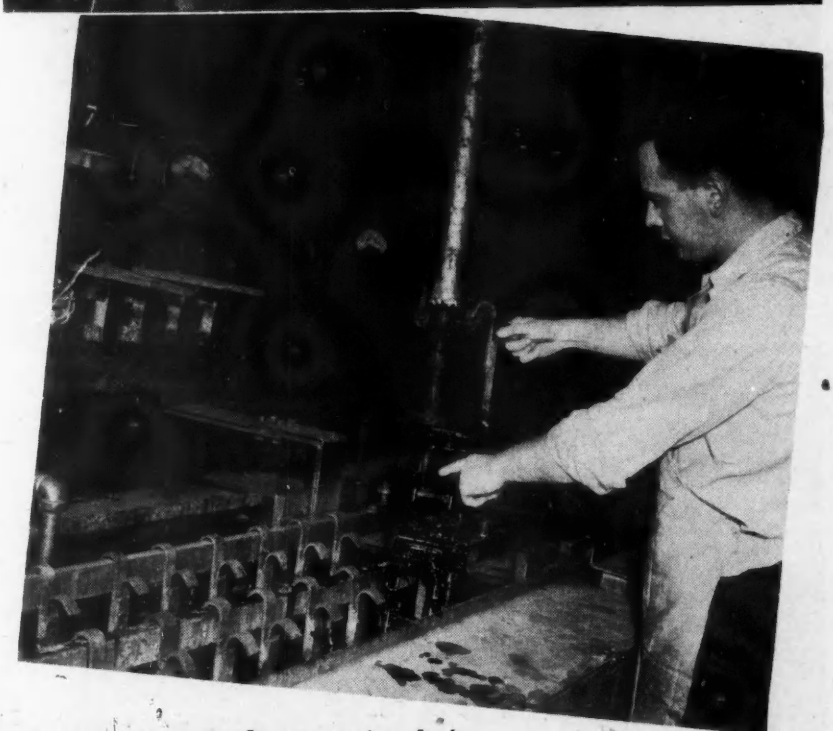

As a part of the tool salvage program, gages and arbors are stripped of chrome, then replated and ground to their original dimensions. This tank is used for the chrome plating operation, a tray of snap gages having just been raised by the worker.

Interior Panels of Plastic with Photographic Reproduction

A PROCESS for incorporating photographic reproductions of leather, wood and fabric patterns in a plastic finish for automobile interior paneling and trim is now being used by the Briggs Manufacturing Co. in the DeSoto Suburban body for interior door and rear-quarter and deck lid panels, and in the Packard Deluxe body for a decorative molding on the back of the front seat.

The new process sandwiches actual photographic reproductions into a durable plastic sheet, using an impregnated core stock of wood pulp, rag board and sizal fiber and a full size photograph of the desired material. Any design in any combination of colors can be used, the manufacturer claims, and the depth and texture of wood and leather finishes can be duplicated. It was also stated that abrasion and scratch tests show that the plastic has a durability surpassing regular wood and wood veneer panels.

Two methods are used for processing the plastic. On large items such as interior panels, the plastic is pressed and baked in flat sheets. Where contours are to be formed, such as on the rear

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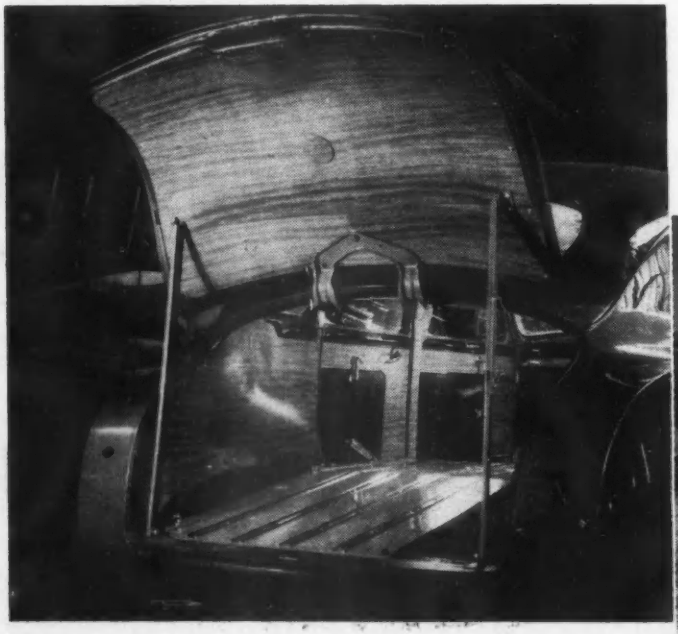
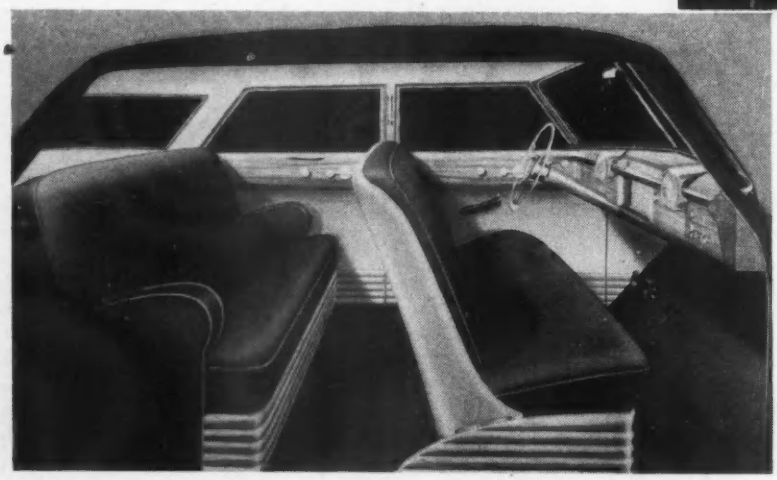


(Above) View of the DeSoto Suburban body showing the use of plastic material to reproduce wood grains on the door panels, center pillar, rear quarter panel, and rear deck lid



(Above) Plastics are used to reproduce two types of wood grains and a leather kick pad at the bottom of the door in this view of the DeSoto Suburban interior. These panels are actual photographic reproductions incorporated into a plastic material

(Left) The automobile interior of the future, as visualized by designers of the Briggs Manufacturing Co., offers plastic head-lining, synthetic seat cushions and floor mat, decorative plastic door panels, window garnish moldings and instrument panel, and plastic steering wheel, knobs and escutcheons

Abstracts *of Recent* SAE Papers

Of the Many Papers Arranged for the Fourth Quarter National Meetings on Tractors, Aeronautics, Production, Fuels and Lubricants, Transportation and Maintenance, Abstracts of Several Are Presented Herewith:

Engine Operation

Oxygen Boost of Engine Power at Altitude

By Francis Masi
Senior Aeronautical Engineer
Aeronautical Engine Laboratory
Naval Air Material Center

Ernest F. Fiock
Principal Physicist
National Bureau of Standards

Robert A. Grosselfinger
Project Engineer
Aircraft Gas Turbine Division
De Laval Steam Turbine Co.

THE practicability of increasing engine power at altitude by injecting liquid oxygen in radial air-cooled engines of service types has been demonstrated by a comprehensive series of ground and flight tests. Fig. 1 is a diagram of such a system for an R-2800-8 engine.

The advantages of such a method of obtaining power boost are that it can be applied readily to existing aircraft and that the complete injection system can be made very light in weight. The total charged weight of a system capable of increasing the power of an R-2800 engine by 300 bhp for a period of 16 min is 179 lb. The principal disadvantage of the system is inherent in the lack of availability and in the properties of liquid oxygen. This substance, in itself, is not an explosive and is hazardous only because it will increase the rate of combustion in any existing fire. In the course of the present tests, 19 tons of liquid oxygen were consumed without accident.

The injection of liquid oxygen did not increase the tendency of the charge in the engine cylinder to detonate. Throughout the entire series of tests, no single instance of engine detonation was ever detected. However, because the injected oxygen is not accompanied by the usual 4 volumes of nitrogen, cylinder head temperatures are higher than during operation on air containing the same total quantity of oxygen. Since these head temperatures approach the limiting permissible values during takeoff at full military power without extra oxygen, the injection of liquid oxygen is to be avoided at all altitudes at which the engine can develop its normal rated power when operated on air alone. The internal cooling produced by water injection can be used to reduce head temperatures under all operating conditions, so that a combination of water injection with liquid oxygen injection has many advantages over either system alone.

From the standpoint of head temperatures and of backfiring, the present results indicate that the total concentration of oxygen in the inducted charge should not exceed 29 per cent by weight. Below this value, it is safe to increase the power of the engine at altitude by the injection of liquid oxygen, thereby achieving worthwhile increases in speed, rate of climb and ceiling of an airplane.

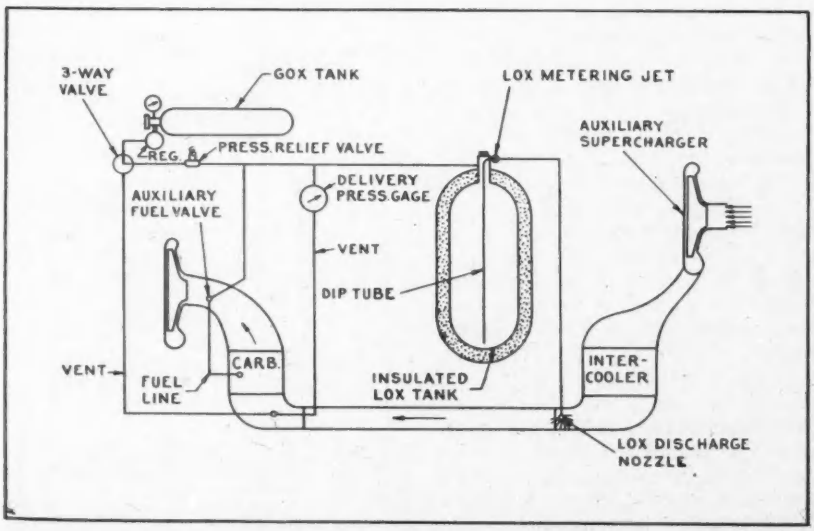


Fig. 1—Diagram of a liquid oxygen supercharging system for a R-2800-8 aircraft engine. LOX is liquid oxygen, and GOX is gaseous oxygen.

Low Tension Ignition — A System of Merit

By John K. Rudd
Project Engineer
Wright Aeronautical Corp.

IN PRINCIPLE the low tension ignition system divorces the secondary winding of the conventional high tension coil from the magneto and relocates it as closely as practicable to the spark plug. Thus the magneto generates a relatively low voltage (approximately 350-v peak) and distribution of the ignition energy to the proper cylinders is accomplished at this voltage, thereby reducing to a minimum the electrical stress in the wiring and the possibility of flashover at altitude. Since distribution is accomplished at low voltage, a secondary or step-up winding is provided near each spark plug to provide the necessary high voltage to fire the spark plugs. The high tension circuit, then, is composed only of the short leads from the secondary windings of these individual coils to their respective spark plugs, as shown in Fig. 2.

A most significant flight test was conducted in which one engine of an experimental test airplane was equipped with low tension while the remaining engines used high tension ignition. The test included more than 100 hr of flight time, and 20 flights to 30,000 ft or higher were made. Since these flights were to high altitude, the integral spark plug and lead assembly was used. For more than half of this flight, test spark plugs were used which had been shown to give trouble from fouling when used with high tension ignition. These plugs

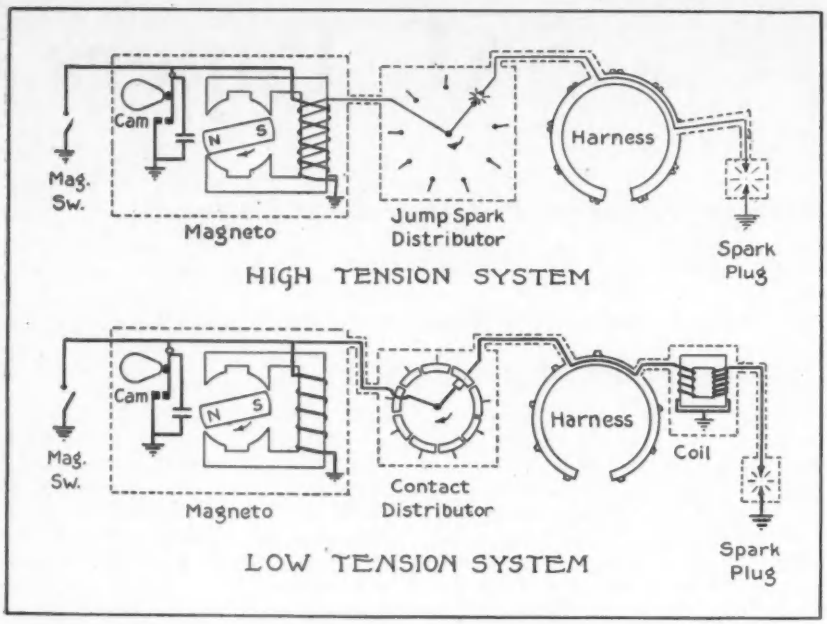


Fig. 2—Comparative wiring diagrams of high tension and low tension aircraft ignition systems

gave good performance with the low tension system, thus demonstrating the systems superiority as regards ability to fire partially fouled spark plugs. During the entire flight test no interruptions were caused by malfunctioning of the low tension system other than a few cases of oil fouling with the test spark plugs mentioned above. The high tension system used on the other engines required considerable maintenance and spark plug fouling and gap erosion were much more severe.

A number of flight test airplanes operated by the Wright Aeronautical Corp. have been equipped with low tension ignition for more than two yr and it has been demonstrated that the system is more reliable than high tension. When installation or maintenance of the low tension system is required, it can be more easily performed because of the many plug-in connectors used which permit detaching the major components from one another.

The major advantages of low tension ignition over currently available high tension systems are:

1. One-half to one-third the normal spark plug gap erosion rate.
2. Less susceptibility to spark plug fouling, resulting in few premature plug charges.
3. Less susceptibility to damage by moisture, heat, and corona discharge.
4. Greatly superior high altitude performance without the need of supercharging.
5. Easier installation and maintenance because of the detachable high tension leads and the plug-in connections in the low tension circuit.
6. Inherently less severe radio interference.
7. Easier starting because the booster spark may be timed to occur at the optimum position without limitation by flashover in the distributor.
8. Less severe electrical stress because of the use of individual transformer coils and a further reduction, in the eighteen-cylinder design, by use of four primary coils and breaker assemblies.

Effect of Crankcase Ventilation On Engine Deposits

By H. L. Moir
and H. L. Hemingway
The Pure Oil Co.

THE purpose of crankcase ventilation is to prevent the crankcase atmosphere from becoming super-saturated with contaminating materials in the blowby gases or those formed as a result of oil deterioration.

Of the standard crankcase ventilation systems now in use, the road draft tube crankcase ventilation system is one of the most common. It has the advantage of being relatively simple, and does not involve a great deal of plumbing. An airdraft past a beveled outlet tube creates a slight vacuum which causes vapors to be discharged. In L head engines fresh air enters the crankcase through a metal wool type air cleaner in the oil fill cap; and in valve-in-head engines, through the rocker arm cover. Circulation is aided by the turbine-like action of the rotation crankshaft.

Fig. 3 illustrates a system used on Ford V-8 engines, air draft past a small slotted projection on the crankpan creates a slight vacuum. Air enters through the metal filtering element in the oil fill cap and is conducted to the crankcase. It sweeps up through the crankcase and through the drain-holes in the bottom of the Vee between the cylinder banks into the valve-valley. From here the air and crankcase vapors are vented through the outlet tube at the right front corner of the valve-valley, which extends down to the outlet on the crank-pan. This type of crankcase ventilation, like the road draft tube system, will function very satisfactorily when an air current, having a velocity of about 20 mph or more flows past the ventilator outlet. Neither system will function satisfactorily under the following conditions:

1. When the engine speed and blowby is high, but vehicle speed is low, resulting in low air velocity past ventilator outlet as in prolonged up-hill operation of a truck in reduced gear.
2. In predominantly low speed operation such as with taxi-cabs or delivery trucks resulting in low air velocity past ventilator outlet tube; however, due to low engine temperatures, crankcase vapors should be removed quickly and thoroughly to avoid condensation on cold engine surfaces.
3. In stationary engines driving air compressors, welders or pumps where there is little or no air draft past the ventilator outlet to promote removal of crankcase vapors.
4. In rear-engine buses or some cab-over-engine applications where, due to the location of the engine or the presence of obstructions, the outlet pipe is shielded from air drafts.
5. In cases where either the outlet pipe or the filter on the ventilator inlet are clogged or restricted. These parts must be kept clean if the ventilation system is to function properly.

Various other methods of ventilation systems employ a ventilator outlet vacuum obtained from the intake manifold or carburetor air cleaner, or from a small electric vacuum driven blower, or from an ejector or aspirator device operated by the exhaust. Variations of the intake manifold method include the

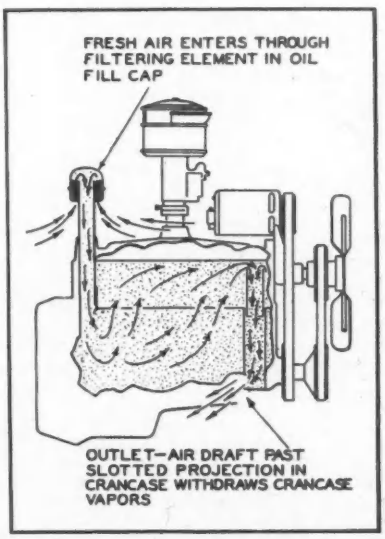


Fig. 3—Crankcase ventilation system used on Ford V-8 engine

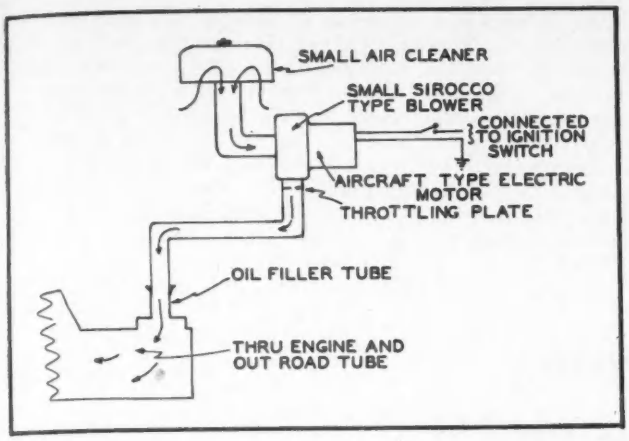


Fig. 4—Schematic arrangement for improving crankcase ventilation through the use of an electric blower

use of a metering valve, and a filter device or condenser. An electric blower system is shown in Fig. 4.

The practice of introducing the crankcase vapors into the intake manifold without proper filtration or condensation in a trap or condenser is considered by most operators to be harmful. A system in which a positive displacement blower draws the vapors out of the crankcase through an outlet tube of large capacity offers the most satisfactory solution to the problem. It is desirable, and in some cases necessary, to have air cleaners on the inlet side of the crankcase ventilation system in order that road dust, sand and other contaminating materials in air cannot enter the crankcase. Another factor to consider is that the tubing or piping employed in the crankcase ventilation system must be of adequate size to facilitate removal of all crankcase vapors without premature plugging. Also it must not be small enough so that it will become inoperative in short periods of time.

Development of Chrome Plated Piston Rings For Aircraft Engines

By John B. Minnich
Assistant Project Engineer
Wright Aeronautical Corp.

ENGINE tests have indicated that the installation of a chrome plated ring in the top groove would nearly double the life of the rings, and that the installation of all chrome plated piston rings would approximately quadruple the ring life. While the testing showed that the chrome plated rings would greatly increase the relative ring life, it did not prove that chrome plated rings were satisfactory for any extended time, under dust conditions. While unplated rings might run for five hrs. chrome plated rings would run only 20 hrs.

A comparison is shown in Fig. 5 between rings made of chrome plated steel, chrome-plated high-strength cast iron (minimum tensile strength 65,000 psi) and unplated standard iron, (minimum tensile strength approximately 45,000 psi). The results of this testing correlate with the breakage experienced in engines. Chrome plated high strength cast iron rings break at about the same rate as unplated standard iron rings, and chrome plated steel rings have broken only in rare occasions at severe test conditions.

The most desirable thickness of plating was investigated to a limited extent. Rings with a flash chrome, approximately .0003 in. thick, were found to be no better than unplated rings. The suppliers of chrome plated rings found that if the plating was much thicker than .006 in. it became difficult to produce a consistent plating on a mass production basis. For this reason, a thickness of .004 to .006 in. was specified, and this was sufficient to last easily one overhaul period.

While chrome plate was found to have very good wear characteristics when applied to the periphery of a ring, it was detrimental when applied to the side faces. This was revealed when rings were tested which had a flash chrome on the side faces and inside diameter as a preventative to corrosion in handling and storage. These rings wore the groove faces of the pistons severely in a few hours.

A fact that was first investigated, and later confirmed, is that chrome plated rings will not run on chrome plated cylinders. Running this combination will invariably remove the chrome from the ring and from the barrel in a few minutes.

Oil Filtration and Its Effect on Engine Wear

By Norman C. Penfold and Donald S. Gray
Armour Research Foundation

ENGINE wear, the removal of metal from piston rings and cylinder

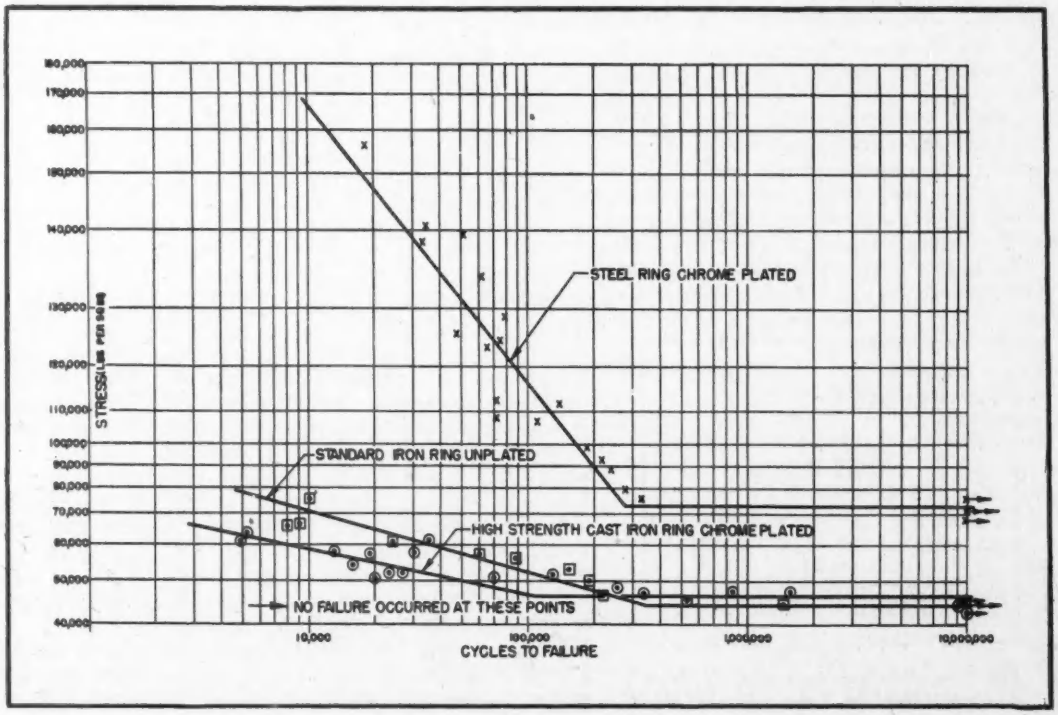


Fig. 5—Comparison of fatigue strength of chrome plated cast iron, chrome plated steel, and unplated cast iron piston rings for aircraft engines

walls, can be increased or decreased in engines operated under controlled test conditions according to the test procedure used. Engine wear rates are influenced by speed and load, start and stop operation, run-in procedure, cylinder and piston ring material and surface finish, abrasive particles introduced into the induction system, coolant and lubricating oil temperatures, the type of fuel, the air-fuel ratio, and by fuel and lubricant contamination.

To determine whether engine wear rates could be effected by filtering the lubricating oil in a test engine with all known variables held constant, a four-cylinder Caterpillar Diesel, having a 4.25 in. bore and a 5.50 in. stroke, was operated for extended periods with partial flow lubricating oil filtration, with a full flow filtration, and with no oil filtration.

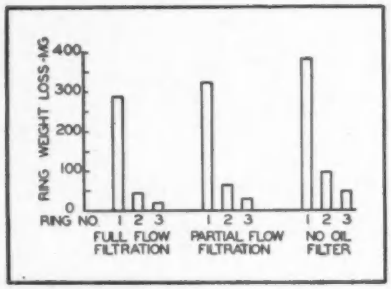


Fig. 6—Piston ring wear in average full, partial flow filtration, and no filter tests

For partial flow system tests a standard absorbent type filter, having a by-pass ratio of 6 to 1, was installed. For the full flow filtration tests, the pressure activated relief valve in the engine oil line was blocked, and a special filter housing with six absorbent filters was installed. For tests in which the lubricating oil was not filtered, the only change in the engine was the removal of the absorbent filter.

Wear rates were evaluated from a determination of the weight loss of the piston rings during a test, the ring gap increase, the dimensional change, the amount of metal in the filters, drain oil and washings and on the increase of iron content in the lubricating oil.

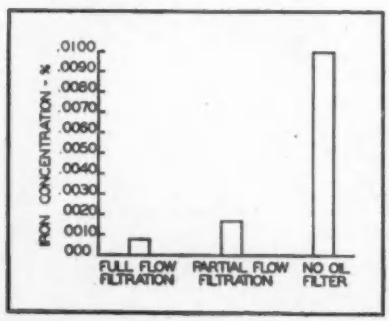


Fig. 7—Average increase of iron concentration in lube oil samples

It was established that at least one-half, and possibly more, of the iron present in the drain oil is metallic iron and, therefore, iron removed from the upper cylinder region, so the results of the analyses of the oil samples, drain oil and washings, and of the filters are comparable with the piston ring wear figures. Within the limits imposed by the test procedure, filtering of engine lubricating oil does reduce engine wear. The test engine operated with no oil filter showed consistently greater wear rates than the same engine operated with a filter, and of the two possible methods of filtering the oil, partial and full flow filtration, full flow is most effective in reducing engine wear. Test results are shown in Figs. 6 and 7.

Diesel Engines

Diesel Engine Requirements for Farm Tractors

By L. A. Gilmer
Chief Engineer
The Oliver Corp.

THIS article is limited to wheel type farm tractors of the sizes currently used as cultivating types, covering a range of about 20 to 45 max bhp at the flywheel, speeds of 1200 to 1600 rpm, and piston speeds rarely exceeding 1200 fpm. There has long been a need for a more efficient power plant for these tractors in regions where the use of gasoline is prohibitive, due to taxes or nonavailability. This includes all export territories and several states in this country where there exist high gasoline taxes which are not refunded to the farmer for off-the-road work.

The most important consideration for Diesel engines for tractors of this type appears to be a means of obtaining a much lower initial cost than has existed in the past. To determine the cost limitations, it is necessary to evaluate the potential savings in operating expense. A study was made of available performance data, and the differences in fuel consumption in gallons per hour were computed with the results shown in the following table:

	Spec Fuel lb per bhp-hr	20 hp Engine gal per hr	30 hp Engine gal per hr	40 hp Engine gal per hr
Full Gasoline	0.55	1.78	2.68	3.58
Load, Diesel	0.48	1.37	2.05	2.74
Difference	...	0.41	0.63	0.84
¾ Gasoline	0.65	1.58	2.38	3.17
Load Diesel	0.50	1.07	1.61	2.14
Difference	...	0.51	0.77	1.03
½ Gasoline	0.80	1.30	1.95	2.60
Load Diesel	0.58	0.83	1.24	1.66
Difference	...	0.47	0.71	0.94

Since the specific fuel figures used in these computations are averages of a number of test results on various makes, it is possible to pick out certain engines of either type in which the performance may be better or worse than that shown. The table indicates that the Diesel engine used, in gallons, 64 per cent of the amount of fuel used by the gasoline engine at ½ load, 68 per cent at ¾ load and 77 per cent at full load. It is interesting to note that the fuel saving in gallons per hour is reasonably constant because the increased spread in part load economy practically offsets the smaller total amount of fuel consumed at part loads.

To check these figures several Nebraska test results were averaged for comparable engines using the two hour variable load test average. The average load in this test is about 60 per cent of full load, and the Diesel engine fuel consumption in gallons is 70 per cent of that of the gasoline engine. For tractor use this would be a very conservative figure.

To convert to cost ratios is more difficult because of the wide variation in prices of Diesel fuels vs. gasoline throughout the country. However, for most territories, the ratio falls between 0.4 and 0.6 with the lower figure representing the territories having a high gasoline tax not refunded, and the higher figure existing where the Diesel fuel price is relatively high and the gasoline tax is refunded. Multiplying the consumption ratio of 0.7 by the cost ratios of 0.4 and 0.6, the resulting operating cost ratio varies between 0.28 and 0.42.

The average of Nebraska test results shows a gasoline consumption of 0.115 gal per bhp per hr on the variable load test. Using 12 cents per gallon as a minimum tax free cost of gasoline to the former and 18 cents per gallon as a representative cost where the tax is not refunded, the obtained cost saving is 0.8 cents to 1.5 cents per bhp per hr. This was done by applying the 0.42 factor to the lower cost gasoline and the 0.28 factor to the higher cost in order to obtain the extreme range of savings.

If the 60 per cent load factor is applied to the hypothetical 20, 30 and

40 hp engines, savings per 1000 hr of operation based on the above figures are $96 to $180 for the 20 hp engine, $144 to $270 for the 30 hp engine and $192 to $360 for the 40 hp engine.

Since the average life of these tractors in the hands of the original owners is probably in the neighborhood of 5000 hr, it appears that the initial cost difference should be offset in not more than 2500 hr to provide any appreciable savings to the farmer. In this time the total fuel cost saving amounts to $240 to $450 for the 20 hp engine, $360 to $665 for the 30 hp engine, and $480 to $900 for the 40 hp engine. Thus it seems that if the tractor cost difference to the farmer could be kept in the range of $400 to $500, the Diesel engine would be justified for all sizes over 30 hp. in all territories including the present typical gasoline sections. For the sizes under 30 hp. the Diesel probably will pay for itself only in the present heavy fuel territories.

In the past this small cost difference has been impossible for several reasons. In the first place, the injection equipment alone has cost more than the complete gasoline engine in any of these sizes. Then there are additional installation costs covering accessories such as a larger air cleaner, more elaborate fuel filtering system, increased capacity oil filter, and more expensive starting equipment. However, the largest item of the great cost difference has been the cost of the basic engine, which, in many cases, ran as high as three to four times that of an equivalent high production gasoline engine.

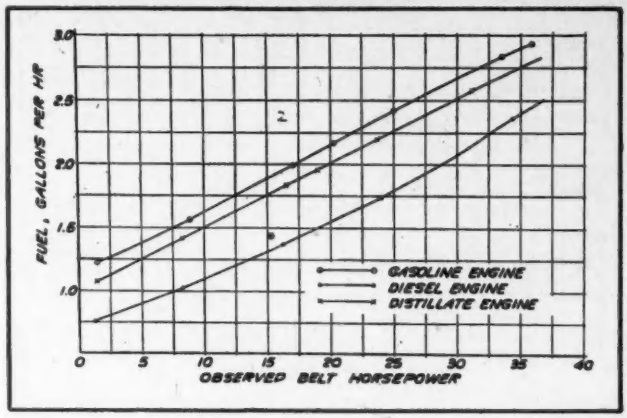


Fig. 9 — Varying load fuel consumption of the carburetted and Diesel engines compared

Table I—General Specifications of the Gasoline, Distillate and Diesel Engines used in the Model M and MD Farmall Tractors

Bore and stroke, in.....	3.875 by 5.25	3.875 by 5.25	3.875 by 5.25
Number of cylinders.....	4	4	4
Valve location	Overhead	Overhead	Overhead
Combustion chamber ...	Anti-knock	Anti-knock	Pre-Combustion
Displacement, cu in.....	247.7	247.7	247.7
Rated engine speed, rpm	1450	1450	1450
Governor control, rpm...	950-1450	950-1450	950-1450
Ignition	Magneto	Magneto	Compression
Magneto and carburetor.	I.H.C.	I.H.C.	—
Fuel injection pump.....	—	—	I.H.C.
Compression ratio	5.65	4.75	14.2
Weight of basic tractor, lb	4415	4415	4755

Economics of the Application of Diesel Power to Farm Tractor Operation

By Harry F. Bryan

Mechanical Research and Development Div. International Harvester Co.

ALTHOUGH the farmer is intensely interested in the improved products and conveniences which advanced engineering can supply him, he is extremely cost conscious. This is particularly true when he is considering the application of the farm tractor to farm operations. The addition of the Diesel engine to the farm tractor line gave him the option of a high compression gasoline engine, a combination gasoline-distillate engine, or a Diesel engine at a moderately higher cost. The war demand for Diesel engines limited the number of these engines installed in the strictly farm type tractor. However, a sufficient number of Diesel equipped units have been in farm operation during the past six years to give some idea of Diesel engine performance in this type of work. This article discusses the performance of the 3.875 in. x 5.25 in. bore and stroke four cylinder gasoline, distillate and Diesel engines in the International Harvester Model M and MD Farmall tractor. The general specifications of the two engine types for this tractor appear in Table I.

The performance results obtained from these tractors when operating on 70 octane gasoline, 38 octane distillate and Diesel fuel have been published in Nebraska Tests, numbers 328, 327 and 368. The varying load results from these tests appear in Table II. These results will be used as a basis for comparison.

The varying load specific fuel consumption of the carburetted and Diesel engines is compared in Fig. 8. The data for these curves are taken from the varying belt load results published in the Nebraska Tests. As the belt horsepower observed in these tests is approximately 94 per cent of the bhp of the engine, it is evident that excellent brake specific fuel consumption was obtained from both engines. The Diesel engine operating with much higher compression at all loads has higher thermal efficiency; therefore, much lower specific fuel consumption is attained. The reduction in fuel consumption at part load is even more marked since there is no reduction of compression pressure in the Diesel due to throttling as in the carburetted engines when operating on light loads.

A natural advantage for both the Diesel and the distillate engines is that, although the farmer purchases his fuel by the gallon, the engine consumes it by the pound. Since the tractor and Diesel fuels are 11 to 15 per cent heavier than

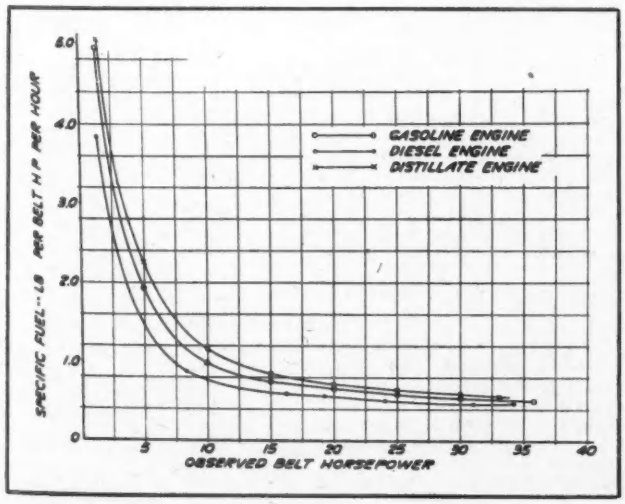


Fig. 8 — Varying load specific fuel consumption of the carburetted and Diesel engines compared

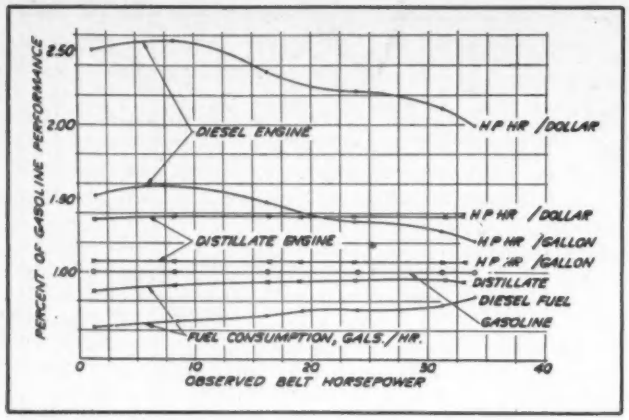


Fig. 10—Comparison of fuel consumption and operating fuel cost. Gasoline, distillate and Diesel engines

Table II—Nebraska Test Data—Fuel Consumption at Varying Load Test. Farmall M.

Tractor Engine	Fuel Consumption	No.	Per Cent of Rated Load			
Gasoline	lb per hp-hr	4.967	1.100	0.717	0.586	0.503
	gal per hp-hr	1.24	5.58	8.57	10.48	12.22
	gal per hr	1.22	1.588	1.998	2.419	2.834
		5.047	1.172	0.773	0.640	0.551
Distillate	lb per hp-hr	1.37	5.91	0.896	10.83	12.59
	gal per hp-hr	1.078	1.407	1.835	2.195	2.623
	gal per hr	3.904	0.864	0.585	0.509	0.485
Diesel	lb per hp-hr	1.79	8.11	11.96	13.76	14.44
	gal per hp-hr	0.759	1.024	1.363	1.740	2.374
	gal per hr					

gasoline and also contain more heat units per gallon, the purchaser of the heavy fuels actually gets more power for his money. Fig. 9 shows the effect of this increased weight on the fuel consumption of these engines. Although the gasoline engine in these tests gave better specific fuel consumption than the distillate engine, the curves in Fig. 2 show it actually consumed more gallons of fuel per belt hp-hr than either the distillate or Diesel engines.

The comparatively large difference in price between gasoline and Diesel fuel is a third advantage in favor of the Diesel engine for farm operation. The present price difference between regular grade gasoline without tax and Diesel fuel in the central area of the United States is approximately 6.2 cents per gallon. Third grade gasoline is one cent cheaper.

The influence of these advantages on the overall difference in fuel cost of the Diesel and carburetted engines is shown in Fig. 10. The data for this chart are also obtained from the Nebraska Tractor Test varying load results. In this group of curves, the fuel consumption, the hp-hr per gallon and the hp-hr per dollar of the Diesel and distillate engines, in terms of per cent of gasoline engine performance, are plotted against the observed belt horsepower. It is evident from this chart that, operating under the Nebraska test conditions with the present fuel prices, the Diesel will deliver more than twice the number of hp-hr per dollar at full load and two and one-half times that of gasoline at one-quarter and no load. If the reduction in fuel cost were the only consideration for farm tractor operation, the Diesel engine would dominate the field.

Turning now to the debit side of the ledger, it is found that the fixed charges for the Diesel and distillate engines to cover depreciation, interest, taxes, insurance, repairs and maintenance are $90.67 and $9.61 respectively greater than for the gasoline engine. This higher initial cost with higher fixed charges will constitute a major handicap to the Diesel engine unless low cost fuel is available and the tractor is used a large number of hours per year.

The relationship between the estimated fixed charges and the fuel cost of the three tractors is shown in Fig. 11. Curves 1, 2, 3, 4, 5, 6, 7, and 8 in this chart are based on the hourly savings of each fuel price combination shown in Table III. The slope of these curves shows the number of hours per year the Diesel engine must operate to absorb the difference in yearly fixed charges through savings in fuel cost. Curves A and B show the estimated excess in yearly fixed charges which must be absorbed by the Diesel engine before any reduction in operating costs can be attained. Curve 1 shows that the Diesel tractor burning 7 cents per gallon fuel

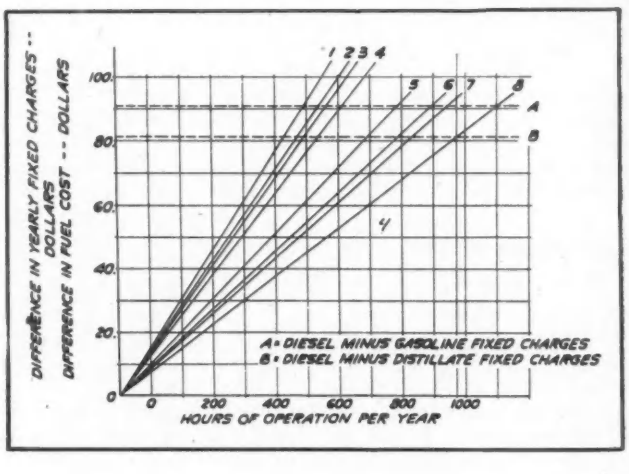


Fig. 11—Relationship between fixed charges and fuel cost, Diesel vs. carburetted engines

Table III—Differences in Hourly Fuel Costs between the Gasoline Engine and the Distillate and Diesel Engines; 972 hr of Operation

Gasoline Engine vs. Diesel Engine

	Diesel Saving per hr
1. 14.2¢ per gal gasoline vs. 7¢ per gal Diesel fuel plus 13.2¢ starting gasoline.....	18.14¢
2. 14.2¢ per gal gasoline vs. 8¢ per gal Diesel fuel plus 13.2¢ starting gasoline.....	16.7¢
3. 13.2¢ per gal gasoline vs. 7¢ per gal Diesel fuel plus 13.2¢ starting gasoline.....	16.12¢
4. 13.2¢ per gal gasoline vs. 8¢ per gal Diesel fuel plus 13.2¢ starting gasoline.....	14.68¢

Distillate Engine vs. Diesel Engine

	Diesel Saving per hr
5. 75% 10.2¢ per gal Tractor fuel plus 25% 13.2¢ per gal gasoline vs. 7¢ per gal Diesel fuel..	11.70¢
6. 75% 10.2¢ per gal Tractor fuel plus 25% 13.2¢ per gal gasoline vs. 8¢ per gal Diesel fuel..	10.26¢
7. 10.2¢ per gal Tractor fuel plus 13.2¢ per gal starting gasoline vs. 7¢ per gal Diesel fuel..	9.77¢
8. 10.2¢ per gal Tractor fuel plus 13.2¢ per gal starting gasoline vs. 8¢ per gal Diesel fuel..	8.33¢

will show a saving over the gasoline tractor burning 14.2 cents per gallon gasoline if the yearly operation exceeds 498 hr, but with 8 cents per gallon Diesel fuel and 13.2 cents per gallon gasoline, 617 hr operation per year will be required before any saving is obtained. Comparing the Diesel and distillate tractors, curve 5 indicates that with fuel combination 5 in Table III, 692 hr operation will be required of the Diesel engine before the difference in fixed charges is absorbed, but when fuel combination 8 in Table III is used as shown in curve 8, Fig. 11, there will be no saving.

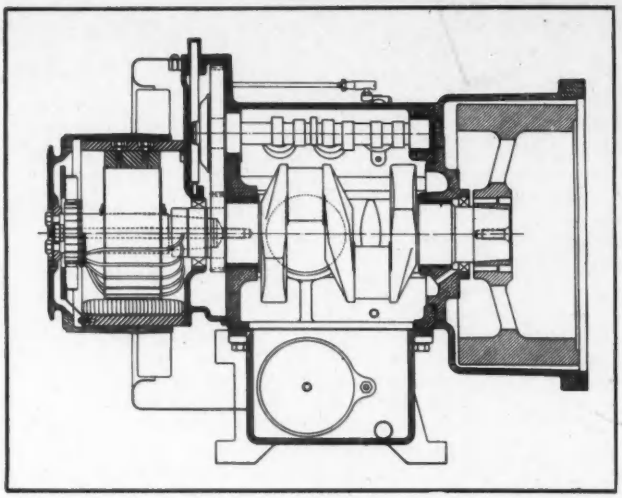


Fig. 12
Drawing shows layout of the direct connected starter and axial flow cooling fan. This two-cylinder, 12 hp, air-cooled Diesel is built by D. W. Onan & Sons

Development of the Air-Cooled Diesel Engine

By J. C. Holby
Chief Engineer
D. W. Onan and Sons

A SMALL Diesel engine of 2.5 to 15 hp capacity applied to applications where the service is short and intermittent and does not run high in total hours of yearly operation, cannot possibly equal the overall economy of a small gasoline engine. If the service of the engine is required for a considerable number of hours each day and the total hours per year are high, the application is ideal. The Diesel driven electric generating set falls into this application, as it is operated from four to eight hours per day, each day of the year. On this basis it is found that the advantages of the Diesel engine, so far as cost is concerned, are of importance in the following order.

1. The Diesel engine will run at least double the number of hours of a gasoline engine between periods of valve and combustion chamber maintenance.

2. Fuel cost. If 2000 hr per year is used as a criterion of total operation, the fuel cost of a Diesel powered generating set running at 5 kw output will require $131.40 in fuel per year. A generating set powered by a gasoline engine at this same output will require $375.00 in fuel per year. This is based on a cost of nine cents per gal for the fuel oil and 15 cents per gal for the gasoline.

3. Special instances such as high property insurance rates where the hazard of gasoline is present, and where Diesel fuel is already available for other engines such as are encountered in some marine applications.

To meet market requirements a two-cylinder engine of 12 hp output at 1800 rpm has been developed by D. W. Onan and Sons. The engine is of the air-cooled, opposed type, with a bore of 3.5 in. and a stroke of 3.5 in. The engine weighs 220 lb and its dimensions are 18.75 in. high, 29.25 in. wide and 24 in. long. The crankcase and cylinder heads are cast iron and contain a precombustion chamber, and except for cooling are of a rather common type. A 17.5 to 1 compression ratio is used with a prechamber volume ratio of 55 per cent. A pintle type nozzle is used to supply fuel to the pre-combustion chamber and individual high pressure injection pumps are mounted on each side of the camshaft which prevents a symmetrical arrangement. Aluminum main and connecting rod bearings are employed and are pressure lubricated by a gear type oil pump. The aluminum main bearings are of Alcoa X-750 alloy containing 7 per cent tin. Maximum main bearing pressure is 1150 psi. Wear on these bearings appears to be less than 0.0003 in. per 1000 hr of operation. The crankshaft is cast nickel alloy iron. The electric starter is direct connected to the crankshaft and it performs the duel function of a motor for starting the engine and a generator for recharging the starting battery. A 12-v starting system is used. Surrounding the generator is a rotating axial flow fan which supplies a larger amount of cooling air to the cylinders at a higher static pressure than a centrifugal type fan and housing for given amount of space.

The engine will start satisfactorily at a temperature of 40° F. At temperatures lower than this, however, additional heat is required. An electric grid type heating element is mounted as an integral part of each oil bath air cleaner. The induction air passing through the air cleaner is pre-heated just before entrance to the combustion chamber. The electric heating elements are permanently connected in the starting circuit of the engine so that the operator need not be concerned about switching them in or out of the circuit during warm or cold weather.

A decompression solenoid is provided on each cylinder head to reduce the initial cranking torque. The solenoid plunger engages with the exhaust valve rocker arm to hold the exhaust valve open whenever the speed is less than 158 rpm. The solenoid is automatically operated by the cranking speed of the engine. It serves the additional function of stopping the engine by remote control or automatic means.

Jet Reaction Engines

NACA Research on Effect of Combustor-Inlet Conditions on Combustion in a Turbojet Engine

By J. Howard Childs, Richard J. McCafferty and Oakley W. Surine
Cleveland Laboratory, NACA

AN INVESTIGATION of the effects of combustor-inlet conditions on the performance of a Westinghouse 19-B combustor gave the following results:

1. At simulated altitudes about 8000 ft below the operational limits, the combustor operated at efficiencies higher than 95 per cent and was capable of producing outlet temperatures far in excess of the engine requirements.

2. As the simulated altitude was progressively increased, approaching the operational limits, resonant combustion began and became increasingly severe; the combustion efficiency decreased; and the temperature rise through the combustor began to pass through a maximum value at a fuel-air ratio within the range investigated (much leaner than the over-all stoichiometric mixture). Both the maximum temperature rise obtainable and the fuel-air ratio at which it occurred decreased as the simulated altitude was increased.

3. High combustor-inlet pressures and temperatures and low combustor-inlet velocities were favorable to combustion. When these combustor-inlet conditions were favorable to combustion, the combustor operated at high efficiencies

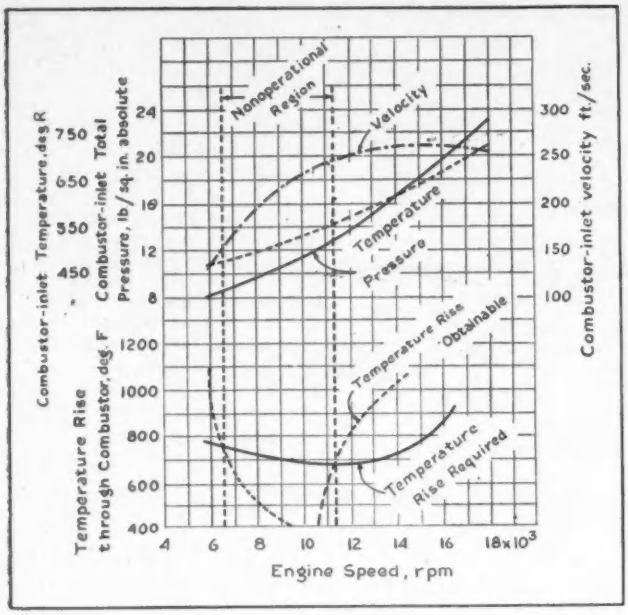


Fig. 13 — Combustor operating conditions in 19-B jet propulsion engine at various engine speeds at altitude of 20,000 ft. Static operation; tail cone retracted

above 95 per cent and the temperature rise through the combustor increased with an increase in fuel-air ratio throughout the range of fuel-air ratios investigated.

4. As any one of the combustor-inlet conditions was altered in a direction unfavorable to combustion, the effect on combustion characteristics was similar to the effect of increasing altitude. The combustion efficiency and maximum temperature rise obtainable decreased and resonance increased if the combustor-inlet pressure was decreased, or the combustor-inlet temperature was decreased, or the combustor-inlet velocity was increased. Both the maximum obtainable combustor temperature rise and the fuel-air ratio at which it occurred decreased as these inlet conditions became more adverse.

5. The existence of altitude operation limits was accounted for by effects of the combustor-inlet conditions occurring at altitudes.

An analysis of the causes of the altitude operational limits can be made by following a constant-altitude path at 20,000 ft, going from low to high engine speeds, observing what happens to engine performance, and explaining these happenings in terms of the effects of the combustor-inlet conditions on combustion performance. The combustor-inlet pressures, temperatures, and velocities existing in the engine at an altitude of 20,000 ft at various rotational speeds are shown in Fig. 13. Starting at 6000 rpm, the combustor produces the temperature-rise requirement of the engine. At this point, the combustor-inlet pressure and temperature are relatively low, and both are therefore adverse to combustion. The inlet velocity is very low, however, and a low velocity has a favorable effect on combustion enabling the combustor to give the required temperature rise.

As the engine is accelerated to higher engine speeds, the combustor-inlet pressure and temperature increase; and these changes are beneficial to combustion. At the same time, however, the inlet velocity increases very rapidly and this change has a detrimental effect on combustion. The adverse effect of rapidly increasing inlet velocity more than counterbalances the beneficial changes in operating conditions, as is evidenced by the decrease in temperature rise obtainable, until the combustor ceases to meet the engine requirements when 6500 rpm is reached.

As the simulated engine speed is increased through the nonoperational region, the inlet pressure and temperature increase at accelerating rates whereas the inlet velocity increases at a decelerating rate with increase in simulated engine speed. At a simulated speed of about 10,000 rpm, the favorable effects of the rapidly increasing inlet pressure and temperature therefore became greater than the adverse effect of the increasing inlet velocity and the temperature rise obtainable begins to increase with simulated engine speed. At a speed of 12,300 rpm, the temperature rise obtainable is equal to the temperature rise required. Above an engine speed of 12,300 rpm, the inlet velocity increases only slightly and approaches a maximum value whereas the inlet pressure and temperature increase rapidly and bring the combustor farther into the satisfactory operating range.

As the engine is accelerated in the high-engine-speed range past the point where the combustor-inlet velocity has passed through its critical maximum value, all of the combustor-inlet parameters are changing in favorable directions and at increasing rates. The slope of the obtainable temperature rise curve of Fig. 13 is nevertheless decreasing, and this is because a given increment in any one of the combustor-inlet parameters produces less effect upon combustion as that parameter becomes more favorable to combustion.

Automatic Control Considerations For Aircraft Gas Turbine Propeller Power Plants

By C. W. Chillson, G. P. Knapp and M. Meyer
Propeller Division
Curtis-Wright Corp.

IN GAS turbine power plants, power available from the turbine increases rapidly as either rpm or temperature is increased, so that for take-off and combat operations, closely controlled operation at the maximum limits of rpm and temperature is of great importance. Fuel economy of the turbine also normally increases at the same time, so that maximum cruising economy will in general be obtained at greater fractions of take-off rpm and power than for reciprocating engines.

Because of the fact that the primary stresses are steady stresses, the materials may be operated relatively close to their elastic limits at the operating temperatures, and even short duration over speeds or over temperatures may be undesirable. The primary functions of a control are, therefore, to control within narrow limits and with a high degree of stability to prevent hunting or mometary over temperature or over speed operation over the full range of altitudes, air temperatures and air speeds encountered. A supplementary function is to permit maintaining temperature and rpm at values less than the maximum, the pilot's control being calibrated in terms of percentage of the maximum permissable rpm and temperature, with biasing corrections for changes in altitude, air temperature, and air speed to maintain approximately these percentages under all flight conditions. The temperature control may be obtained either directly, or if found more practical, by control of some quantity related to temperature such as fuel-air ratio or output torque.

The problem of obtaining stable and precise control of rpm and turbine temperature is complicated by the inherently characteristics of the system. Propeller blade angle and rate of fuel flow are the two primary variables with which to control rpm temperature. Without considering which of these variables controls rpm and which controls temperature, it is evident that under steady ambient and flight conditions, an increase of fuel flow will produce an increase in rpm and also, at least transiently, an increase in turbine temperature. Similarly, a change of blade angle will produce a change in rpm and generally a change of turbine temperature. Thus while a single automatic control operating on either blade angle or fuel flow could be made to control either rpm or temperature stably, changes in the setting of the controlled variable would result in changes in the uncontrolled variable. If two such controls were operated simultaneously to control *both* rpm and temperature, a correction by one control would create

(*Turn to page* 56, *please*)

New Production and Plant Equipment

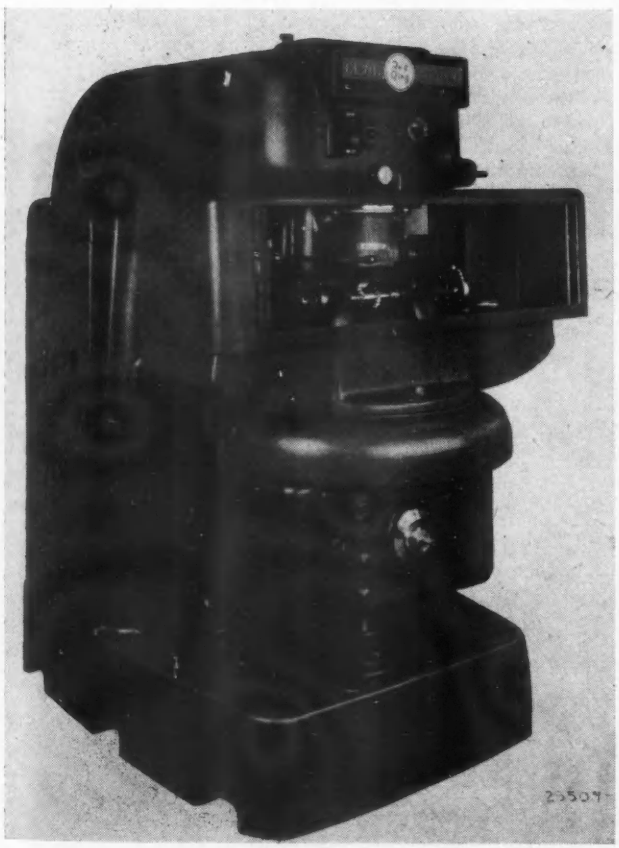
NATIONAL BROACH AND MACHINE CO., 5600 St. Jean Ave., Detroit 13, Mich., has incorporated a new mechanical principle in its Red Ring diagonal gear shaving machine.

Heretofore, the direction of feed of Red Ring machines has been parallel to the work gear axis. In this new machine, however, the work is fed at an angle to its axis, the angle being selected with reference to the dimensional and physical characteristics of the gear being shaved. The angle is also selected to obtain optimum conditions for both cutting speed and surface finish.

The diagonal traverse facilitates the shearing action at each cutting edge, thus making it practicable to remove more stock per cycle and in less cutting time. The entire cutting cycle is composed of just two passes through the cutter. Another advantage is that the full face of the cutter is effective during each cutting cycle, thus materially extending cutter life.

With diagonal traverse there is no restriction on the face width of the cutter. By this process cutter face width may be considerably less than the face width of the work gear and no special cutters are required. Conventional cutters are adequate and cutter serrations need not be staggered.

The center distance between cutter and work gear remains constant throughout the complete run of any size of work gear. The operator does not have to take time to raise the knee each time he loads a gear and lower it each time he unloads. Loading time and unloading time will be further reduced by the addition of a new quick-loading tail-stock.



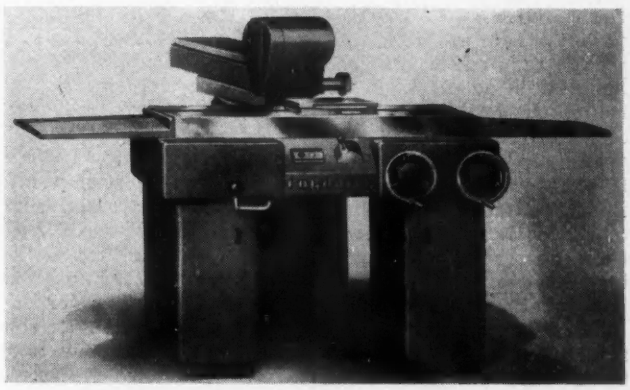
Red Ring diagonal gear shaver

COLONIAL BROACH CO., Box 37, Harper Station, Detroit 13, Mich., offers a broach sharpening machine that is said to make it possible for the operator to sharpen flat surface broaches several feet long while comfortably seated. The manner in which this has been accomplished on the Colonial FS3-36 flat broach sharpener is as follows:

To permit the operator to comfortably sit close to the machine the base is built up out of three pedestals. Two of these support the table at either side, forming a deep knee-hole at the back of which is the third pedestal supporting the grinder head.

Two hand-wheels, for controlling lengthwise movement of the table and for raising and lowering the grinder head are located at the right side of the knee-hole rather than in the center of the machine.

The main operating control on the machine is the "lazy-reach" lever, with which the grinding wheel is moved back and forth across the face of the broach teeth to sharpen them. This lever is mounted on the front of the machine within easy reach of the operator. Furthermore the control is adjustable up and down, in and out, and radially so that the tool grinder can set it to what is to him the most comfortable operating position. The cross-slide carrying the grinder head is of light-weight construction and is mounted on ball bearings at both top and bottom.



Colonial broach sharpening machine

Adjustable cushioned stops guard against shock at the end of the travel of the cross-slide. Start and stop buttons and a magnetic chuck switch lever (available as extra equipment) are located in the front center of the machine.

Length of the table is 48 in., with a 36-in. table travel. Even longer broaches can be handled by extending one end of the broach beyond the table while sharpening the other.

The grinding wheel spindle can be operated at various speeds ranging from 4000 to 10,000 rpm through the use of interchangeable pulleys.

(Turn to next page, please)

Salsbury industrial truck

A NEW type of industrial truck, patterned after the swiveling gun turrets of fighter planes, has been devised by Salsbury Motors, Inc., Pomona, Cal.

The Salsbury "Turret," used as the power unit of a line of industrial lift-trucks, tugs and cargo trucks, is a cylindrical hood 2 ft in diameter. It houses the Salsbury "Power-Package," consisting of a 6-hp. gasoline engine geared to a drive wheel through a fully-automatic clutch and transmission. Mounted in the small industrial trucks designed for it, with the drive wheel on the ground, the Turret can be instantly turned to provide power in any direction.

The automatic transmission, which shifts down for heavy loads and gears up for light pulling, and the automatic clutch which engages automatically, eliminate gear shifting, and the operator needs only feed gasoline to go, and apply his brake to stop. No reverse gear is needed, since the Turret turns completely around.

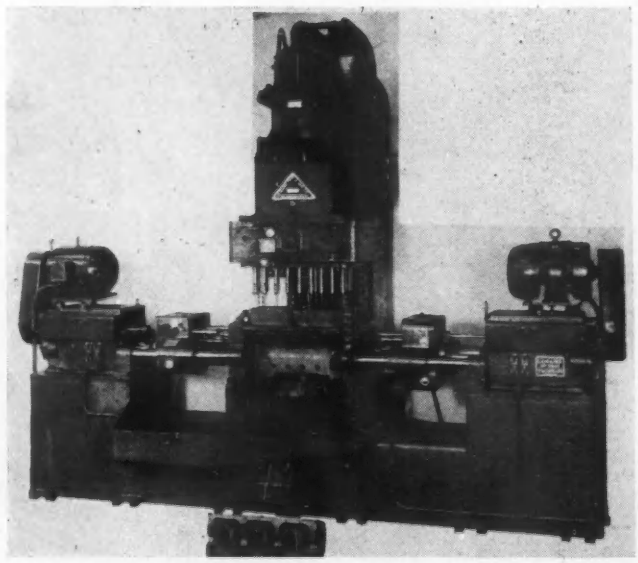
LE MAIRE TOOL & MFG. CO., 2657 Telegraph Rd., Dearborn, Mich., has designed and built a special three-way machine for drilling the bottom and ends of automobile engine cylinder blocks.

This machine consists of a one-piece base on which LeMaire No. 5000 Twin Ram units with multiple-spindle heads are mounted at each end and a LeMaire No. 20 drilling machine, less table and base, is mounted at the rear. A bridge-type fixture incorporating all drill bushings is provided. Wear strips, guide rails and adjustable stops are used for primary approximate positioning of part in fixture. A toggle-type elevating device operated by an air cylinder jacks the part up against its pan face. The part assumes final location by engaging stationary pins in fixture with the locating holes during this clamping operation.

Operations performed are: drill holes at rear of block, drill 37 holes and combination drill and counterbore one hole in pan face of block, drill five holes, counterbore one hole, and combination core drill and counterbore one hole at front of block.

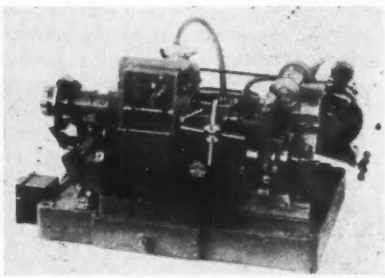
THE GENERAL ELECTRIC CO., Schenectady, N. Y., has redesigned its complete line of synchronous precision controls for resistance welding machines. All components in the new line, plus the control station, are housed in one cabinet. It is designed for spot and projection welding on air-, fluid-, motor- and foot-operated resistance welding machines. Although arranged for mounting on the right-hand side of the welding machine, it may be placed on the floor, or on a nearby wall or balcony if floor space is at a premium.

Components of the control system include ignitron contractors, a weld timer, electronic heat control, and, as optional equipment sequence controls and tempering control. The single enclosure is designed so that the control station always faces the operator. All the components with the exception of the ignitron contractors are mounted on hinged panels which can be swung out without interrupting service.

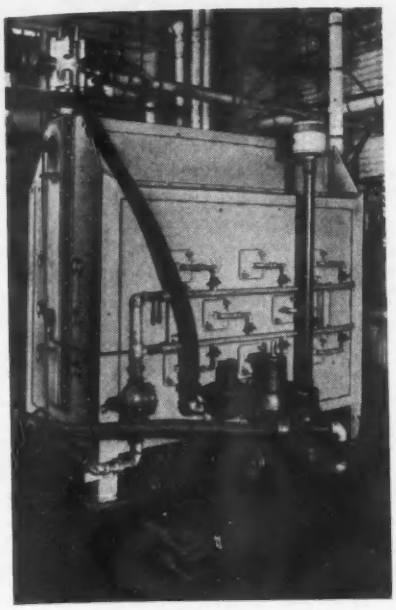


LeMaire three-way drilling machine

A PINION and gear cutting machine with capacity up to 2.25 in. pitch diam with 2 in. length of cut is offered by the Waltham Machine Works, Waltham, Mass. The machine may be used for bench or pedestal operation. Motor and control are attached to the machine. The manufacturer believes that this machine will be an excellent unit for cutting gears or pinions of sizes larger than those used in watches. It is an automatic single cutter machine for straight teeth only, with the revolving cutter making successive cuts on blanks held and indexed by the work spindle and supported by tail center. The machine stops with cutter lifted clear of work. The reservoir base can be cleaned from the front. Machine is supplied with a pump which delivers a supply of coolant directly on the work at point of cutting. The motor is connected to a shaft that drives the cutter spindle, coolant pump, and indexing mechanism by two endless V belts, each with idler take-up. This shaft also drives the cam shaft through a worm and gear. The standard work slide cam allows an adjustment of strokes between 1.4 in. and 2.4 in. For pinion work a shorter throw cam can be furnished. Cutters used on this machine would regularly be 1 in. diam with ⅜ in. hole, but if necessary, arbors for other dimensioned cutters can be supplied.



Pinion and gear cutting machine

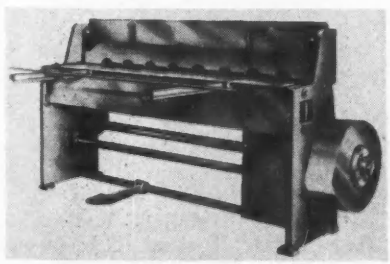


Selas superheater

STEAM, air and other gases are superheated by a continuous-heating method in the Selas superheater, made by the Selas Corp. of America, Erie Ave. west of D St., Philadelphia 34, Pa. This superheater is small and compact and brought to operating heat in a matter of minutes. Temperatures to 2000 F are uniformly maintained at pressures limited only by characteristics of heating coils.

Design of Selas superheaters lends itself to adaptation for individual heating requirements. Duradiant Burners, which transmit a high percentage of heat by radiation, are patterned on each side of the superheater to produce the desired heat gradient. Thus, sufficient quantities of steam or air, economically superheated, are available on short notice. The superheater is mounted on wheels so that it can be moved about the test-bay as required.

PARKER MANUFACTURING CO., Santa Monica, Cal., introduces a new line of all-steel power squaring shears for all types of shearing and trimming up to 14-gage capacities, to be known as



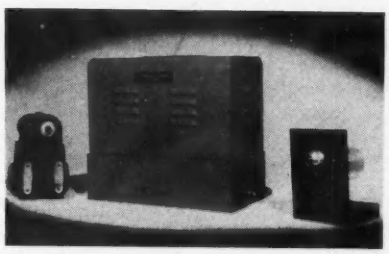
Parker squaring shears

Parker power squaring shears. Built from extra-heavy steel plate of box type design, welded and normalized to relieve stresses, Parker shears are said to possess maximum strength with minimum deflection.

Standing 47 in. high, Parker shears have a low center of gravity. Cutting length is 73 in., blade length, 75 in. Back gage range 18 in., front gage range 38 in. Strokes per minute (50 or 60 cycle) 85. A 2-hp motor is furnished with each shear. Approximate shipping weight is 2750 lb.

Four-way, high carbon tool steel blades are used. Extra long gibways insure long blade life and straight line shearing. Parker shears will cut drawn or folded parts within 1½ in. of the shoulder, thus deep-drawn objects may be trimmed close.

A SERVOMECHANISM has been developed by G. C. Wilson & Co., 2 N. Passaic Ave., Chatham, N. J., for remote indication or control. The servo consists of a torque unit, an amplifier, and a control unit. The position of the shaft on the torque unit is controlled by the amplifier to correspond to the control unit. The system is sensitive to 1 per cent changes in the control unit which requires approximately 1 oz-in. of torque for operation. The torque unit develops

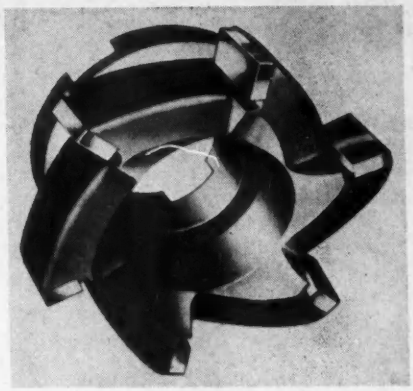


Servomechanism for remote control consists of torque unit, amplifier, and control unit

a maximum of 50 lb-ft of torque. The amplifier unit consists of three radio type vacuum tubes and associated equipment. A safety feature is provided in a signal light associated with the control unit which indicates correct operation of the system. The system operates from 115v 60 cycle power supplied at the amplifier.

A SPECIAL dual automatic keyway cutter has been designed and built by Snyder Tool & Engineering Co., Detroit,

Red Streak Shell End Mills



The Vascoloy-Ramet Corp., North Chicago, Ill., announce a new line of Red Streak carbide tipped and Blue Streak Tantung tipped shell end mills, manufactured in right and left hand styles, ranging in size from 2½ in. OD to 4½ in. OD and bores 1 in. to 1½ in. The Red Streak carbide tipped shell end mills are available with negative radial and axial rake angles for milling steel and zero rakes for milling cast iron, non-ferrous and non-metallic materials.

Mich. At each station, two keyways are cut in a large crankshaft. Work parts are clamped hydraulically, and loading and unloading is performed at one station while the other is in operation. Push button control activates the automatic cycle. Spindle slides are provided with rapid advance and return, and hydraulic feeds are readily adjustable. Fixture is automatically indexed away from the cutters to assure easy loading and unloading. Safety limit switches prevent the machine from operating before a part is safely clamped. Spindles are worm-gear driven and drive high speed steel cutters with integral shank. These are tightly held by draw bolts and further supported on live centers in the outboard spindle bracket. Cutting speed is approximately 40 ft per min. Machine base and column are welded steel construction, thoroughly normalized and properly ribbed, and lubrication and coolant facilities are provided.

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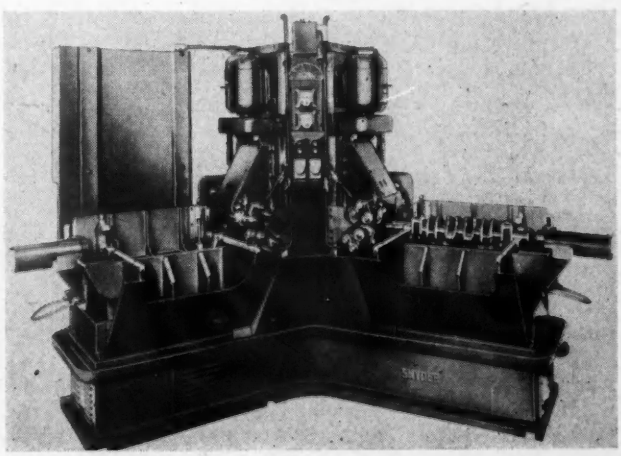


Dual automatic keyway cutter

Airbriefs

by Robert McLarren

Technical Review

As the year 1946 draws to a close it is of interest to review the technical achievements in aeronautics of the year and to register in summation the most outstanding. Accordingly we present this month the outstanding technical highlights of the year in aviation together with brief notes on their promising significance. The developments that follow are not necessarily in an order of importance but will, it is sincerely hoped, constitute a brief technical diary of the year.

Long-Distance Flights

The world's airline distance record flight of 11,260 miles by the Navy's Lockheed XP2V-1 "Truculent Turtle" and the 9500-mile non-stop flight by the AAF's Boeing B-29B "Pacusan Dreamboat" constituted a dual operational achievement by the Services unmatched during the year. Considerable credit is due the crews of the two planes and the Services they represent for finding solution to the many detail technical problems involved in such operations. Real significance of the flights, however, lies in the reality of the 10,000-mile bomber, both as an engineering accomplishment and an operational attainment. Both aircraft are of conventional design and size and lend emphasis to the strategic possibilities of newer and larger types recently developed. Assuredly these two flights brought the Army Air Forces and Naval Aviation to new goals of achievement and presaged a new era in long-distance aircraft operation that is certain to become commonplace within the next decade.

Giant Aircraft

Among the 26 new prototype aircraft announced during the year, three stand out as technical achievements of major importance. For sheer size alone, no aircraft successfully flown in history rivals the monster Consolidated-Vultee XB-36 bomber, which flew for the first time in August. The giant craft has a gross weight of nearly 140 tons and is powered by six 3000 hp engines. And endless source of fabulous figures, the XB-36 carries 21,116 gal of fuel, carries a crew of 16 and will fly for 10,000 miles with a bomb load of 10,000 lb.

The Northrop XB-35, which made its first test flight in June, represents the first successful full-size flying wing aircraft in history and the culmination of more than 20 years intensive research and development work. With a gross weight of only about 100 tons, the XB-35 is capable of the same "10,000 miles with 10,000 lb of bombs" performance as the XB-36, indicative of the gains to be had from the "all-wing" configuration. Assuredly the flying wing will grow rapidly in importance in the next few years, particularly with the successful use of turbojet engines in the type, now scheduled for installation in the coming year.

First flight of the Lockheed XR60-1 Constitution in November brought another "giant" into the air transport stable. Designed to accommodate 168 passengers in two decks, the huge craft weighs 92 tons and has a top speed of more than 300 miles per hour.

Technical achievements in these three planes comprised more than sheer size and weight. Their operating requirements for runway distance proved far short of early predictions with the B-36 getting off in 4000 ft, the B-35 in 3000 ft and the R60 in 2000 ft. Similar accomplishments are evident in their performance, maneuverability and load-carrying capacity. Assuredly a new era in large aircraft design was ushered in during the year.

Trans-oceanic

It is difficult to assess quantitatively the remarkable technical progress made during the year in scheduled trans-Atlantic flight operations. Following allocation of routes last year countless technical problems confronted the airlines before reliable frequent schedules could be realized. This year has seen an astonishing growth in overseas airline operation but the increased frequency of schedule and number of passenger-miles flown reveal little if any of the remarkable progress made in technical operations. Much of war-developed technique was exploited and this, together with domestic experience augmented to one of the major accomplishments in the history of scheduled air transportation.

Helicopter Progress

This year saw the first official Civil Aeronautics Administration certification of approval for a helicopter, the first regular trial of helicopter-delivered mail, the first use of helicopters in privately-owned commercial operation and endless "firsts" of minor nature. Volume production of helicopters for public sale was well under way during the latter part of the year and deliveries have already begun. The first twin-engine helicopter was flown in June and as the year drew to a close more than 20 separate models and types were undergoing dvelopmnt. Numerous detailed technical problems were solved and in few aeronautical fields was more engineering resourcefulness shown during the year than in the helicopter field.

Propjet Engine

The first successful American propjet engine, the General Electric TG-100, underwent extensive flight testing during the year. Although the first flight of the unit actually took place in December of last year, 1946 witnessed the real operational birth of this unique power unit which has been widely accepted as the most immediately required type of the gas turbine-operated group of engines. Revealed for the first time to the public at the National Aircraft Show in Cleveland was the long-secret Northrop Turbodyne, an axial-flow propjet engine, giving the United States projects in both these major types of propjet designs. At least two new airline models are scheduled for adaption for propjet power units during the coming year, which should produce interesting progress in this field.

Sandwich Material

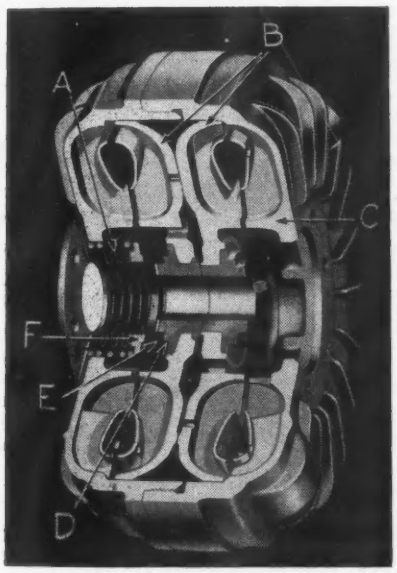
Although research and development work on soft-core, sandwich-type materials was pressed throughout the year, the first airplane built entirely from this new material was announced in November. It is the Vought XF6U-1 Navy fighter plane powered by a Westinghouse 24C axial-flow turbojet engine. The entire structure of the plane is formed from "Metalite," a Vought-developed material made up of two thin sheets of aluminum alloy bonded to a balsa wood core. Its use eliminates considerable stiffening members formerly employed, it provides a far smoother surface and it is lighter in weight than comparable stressed skin structure. The vast number of processes and compositions undergoing development during

(*Turn to page 76, please*)

New Products

Small Hydraulic Couplings

A new series of small hydraulic couplings for use with induction motors and small internal combustion engines has been announced by the Twin Disc Clutch Co., Racine, Wis. The six couplings in the new series have various ratings, ranging from one to 25 hp at 1,800 rpm. The following advantages are said to be gained by using hydraulic couplings with induction motors and small internal combustion engines: They assure smooth acceleration; prevent stalling; allow the engine or motor to be fitted to actual running requirements; eliminate the need for sheer pins and similar "break-and-replace" protection for driven parts; distribute the load on multiple engine or motor drives; permit the reversing of electric motors at full-load speed without high current surges; and, in case of a standard motor, permit the motor to start under no load and thus makes high torque available for starting.



Cross-section view of Twin Disc small hydraulic coupling

A—Copper bellows seal. B—Runners. C—Impeller. D—Synthetic rubber mating ring washer. E—Compressed graphite mating ring. F—Bearing steel nose piece for bellows seal.

All but the smallest of this new line of hydraulic couplings retain in their design the customary Twin Disc double circuit, which consists of two sets of blades on both the driving and driven members of the coupling.

Both the impeller, or driving member, and the runner, or driven member, are lightweight aluminum castings. A cast iron insert forms the hub of the driven member, taking the drive to the output shaft. Stamped steel core rings in both the impeller and the runner form the hydraulic circuit.

The unit is assembled by installing the runners and then screwing together the impellers with a rubber or coprene ring to insure against leakage.

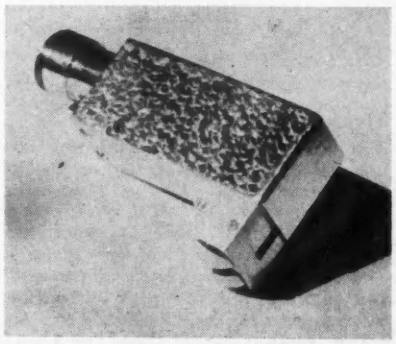
Korolac Solutions for Coating Plating Racks

A Korolac solution for the coating of electro-plating and pickling racks has been developed by the B. F. Goodrich Co., Akron, Ohio, which embodies the chemical inertness of Koroseal tank lining. The new product is known as Korolac RX-2500.

A second new development, known as Korolac primer No. A-208-B, is used in conjunction with Korolac RX-2500, to provide adhesion of the Korolac coating to the metal rack. This primer is brushed onto the rack and areas adjacent to the contact points, thereby preventing contamination of plating baths by carry-over of solutions underneath the protective rack coating.

New Hand-Operated Profilometer Tracer

A self-adjusting, hand-operated Profilometer tracer has just been introduced by Phyicists Research Co., Ann Arbor, Mich. Known as the Type MA, the new tracer replaces the Type M tracer as standard equipment with all Profilometers. It is also available separately.



Type MA tracer for use with Profilometers

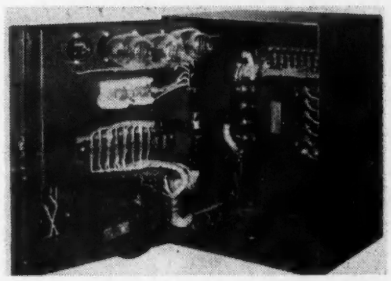
Convenience and efficiency are enhanced by the elimination of the adjustment of the tracing point to the surface being measured. Operation of the new Tracer consists of placing the tracer on the surface, moving it to and fro, and noting the microinch reading.

The Type MA tracer is considerably smaller than the old Type M; it will go completely through a 1½ in. ID. Only two skid yokes are needed to handle all surfaces. No adaptations are needed to use the tracer with any Profilometer now in use.

Electronic Motor Control

Weltronic Co., 19500 W. Eight Mile Rd., Detroit 19, Mich., has brought out a small electronic motor control for use on any shunt-wound, dc motor up to and including ½ hp. For applications where automatic compensation for changing load and changing line voltage is not required, this unit offers a small, compact control including all the necessary features for motor drives on lathes, drill presses, winding machines, milling machines, etc.

Operation is from 230 volt a-c single-phase power source and the output is for 230 volt d-c motors. The armature voltage is continuously variable for speed control from zero to base speed of the motor. This variable voltage is supplied from the tap of a continuously-variable autotransformer which is manually controlled by a large knob on the front of the cabinet. The variable voltage furnishes power to a four-tube bridge rectifier supplying direct current to the armature of the motor. The field voltage is taken from a fixed tap on the autotransformer and remains constant. A bridge-type rectifier circuit also is used for the field current.



Weltronic electronic motor control

In addition to the manual speed control knob, a switch on the front of the cabinet provides for forward, reverse or stop operation. The panel containing the switch and the dial can be removed and remotely installed.

Allis-Chalmers Pumps

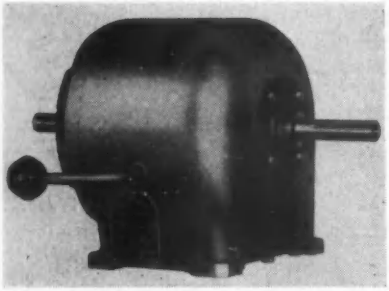
The Allis-Chalmers Mfg. Co., Milwaukee, Wis., announces a new line of "Pedrifugal" pumps, developed at its Norwood Works. This new line of cast iron, bronze-fitted, pedestal-type centrifugal pumps comes in three principal

sizes—one-in. by one-in, two-in. by two-in. and three-in. by three-in. Capacities are from 10 to 500 gpm at heads from 10 to 100 ft., with power requirements from ¼ to 15 hp. The units are splatter-finished with gray enamel.

"Pedrifugal" pumps are expressly designed for use with Texrope V-belt drives, giving an infinite range of capacities regulated by size of sheaves and power supplied. All the pumps are fitted with impellers of maximum diameter, and variations in capacity are provided by changes in speed through sheaves of larger or smaller diameter.

Separate Motor Driven Gearshift Drive

The Lima Electric Motor Co., Lima, Ohio, has made a new addition to its line of selective speed gearshift drives. The new drive, identified as Type RD, is designed to motorize machinery requiring selective speeds, and can be



Lima Type RD separate motor driven selective speed gearshift drive

used with any standard motor of ¼ hp. to 1 hp. rating.

Gear ratios of the new Type RD are 1 to 1, 1.33 to 1, 2 to 1 and 4 to 1. These ratios are such that speed changes occure in even steps.

The Type RD is a four-speed transmission, similar in design to that used on direct motor driven Lima gearshift drives. A unit cast gear box provides permanent alignment. Gears and bearings are adequately lubricated by a permanent oil bath.

The shift lever is available in four optional positions. A speed selection chart facilitates selection of output speeds. The Type RD will operate in either direction of rotation.

AC Spark Plugs for Marine Use

Two new type spark plugs especially suited to marine use will be placed on the market early this year by the Electric Auto-Lite Co., Toledo, Ohio.

A new series of "Transport Plugs" featuring alumina insulators and oversize electrodes will be available in 14 MM; 18 MM and ⅞ in. 18 thread sizes.

The second series is a line of shielded automotive plugs which, in combination with a newly-developed synthetic rubber grommet connector, will enable the boat owner to have a water and explosion proof spark plug set-up.

Rivets Made of Plexiglas

Rivets made of Plexiglas capable of being used in the fastening of light metals, leather, cardboard, rubber, upholstery, and plastics, have recently been developed by the Douglas Aircraft Co., Santa Monica, Calif.

When used on fragile materials these acrylic fasteners can be clinched without shock by heating and expanding the rivets with air pressure of a spring loaded mechanism. After forming a bond, the exposed parts of the rivet may be turned into decorative effects by further heat application, expanding the plastic into a variety of shapes and forms.

Both solid head and hollow shank rivets can be made by the new process. The heat-expansion method of insertion allows the shatter-resistant rivets to be used as "blind" fasteners where only one side of the assembly is accessible. If a rivet is found defective after fastening, it may easily be withdrawn by heating the flattened end with a hot rod, reducing the end of the original shank shape. If desired, rivets may be redriven.

Heavy-Duty Power Take-Offs

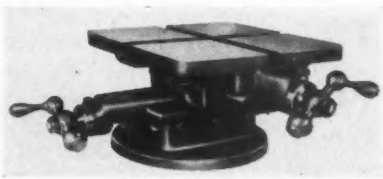
Production will be begun this year on eight standard models of Davey heavy-duty power take-offs by Davey Compressor Co., Kent, Ohio.

The Davey power take-off uses, as its basic principle, an internal and external gear drive, operating as a spline. Installation is made to the rear of the truck transmission case. The power take-off then becomes an integral part of the drive shaft assembly for transmitting power direct from the truck engine either through V belts or chain drive.

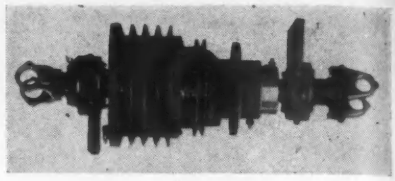
The eight power take-offs are available in three separate capacities. These are 50, 75 and 100 hp.

The Model 50 take-off is manufac-

Two-Way Sliding Table



A small, heavy duty, two-way sliding table has been introduced by the Leo G. Brown Engineering Co., 1127 Riverside Drive, Los Angeles 31, Calif. The table is precision built with an accurately gauged travel of 5 in. in each direction, and is designed for quick mounting to any drill press. Table top is 7.5 in. square and is fitted for 1 in. T-bolts. It is 3.75 in. high overall weighs 24 lb

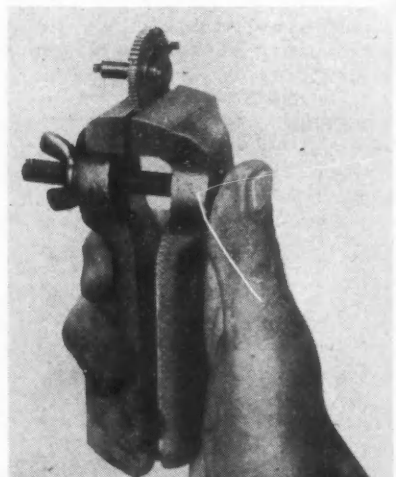


Davey power take-off

tured in both single and simultaneous drive designs. The latter permits operation of truck, or individual operation of driven equipment, or of both simultaneously.

Models 75 and 100 are manufactured for single drive, simultaneous drive and also for double drive. With double drive take-offs, the truck may be operated alone, either of two pieces of driven equipment may be operated individually, or both pieces of driven equipment may operate simultaneously.

Aluminum Hand Vise



The Chicago Tool and Engineering Co., 8383 S. Chicago Ave., Chicago 17, Ill., offers this new aluminum hand vise, known as the Palmgren No. 15 hand vise, that is said to grip solidly without scratching the work. It is only 7 oz in weight and 5 in. long. The 1½ in. wide jaw faces, which open to 1½ in. are accurately machined to provide a true surface. Made of aluminum, they are sufficiently softer than most pieces held to provide a grip that prevents the jaws "biting" or marring the work

Buy More Savings Bonds

NEWS *of the* Industry

Automotive Industry Goes into 1947 with Better Prospects than Year Ago . . . Costs of Materials Creeping Upward . . . Differences Between 1947 and 1946 Models to be Almost Negligible . . . Delivered Price of Cars Raised by Increase in Freight Rates . . . More Trucks Used by Automotive Manufacturers for Short Hauls . . . Production Difficulties Reduce Kaiser-Frazer Bonus Payments.

Although the automotive industry goes into 1947 with much more promise than existed at this time a year ago, when General Motors and Packard both were closed, some of the disturbing elements of last year still are very much in evidence. During 1946, the industry finally managed to get ahead of parts shortages and crippling price controls, but at year-end still was laboring under the handicap of a short supply of sheet and strip steel and some other basic materials. Even so, production during December was rolling along at 80 per cent or more of the 1941 weekly average level.

The biggest potential trouble, as last year, lies ahead in the field of labor. Sparked by the Nathan report which contends that industry in general can increase wages by as much as 25 per cent and still not raise prices, the UAW-CIO has thrown in its initial demand for an increase of 23½ cents an hour plus other concessions, such as employer-financed health and accident insurance and retirement plans, equalization of pay rates in all plants, portal-to-portal pay, and a guaranteed annual wage. Since it is traditional with unions to ask for much more than they expect to get, the general opinion is that settlement will be at a lower figure than the 23½ cents an hour demanded, but there is enough pressure involved to cause potential trouble. However, while no one can predict with any degree of certainty how far organized labor will go to force its demands, the thinking right now is that there will not be nearly so much strike trouble this year as last. There is much to support that belief. Workers do not have the financial reserves to withstand a long strike after a year of rising costs and intermittent employment. Union treasuries also are depleted. This time the union cannot depend on the government to pull its chestnuts out of the fire. And probably most important of all is the rising tide of public impatience with strikes which cut off badly needed goods. There is some evidence that this same opinion is beginning to pervade the rank and file of labor itself. The combination of all these factors indicates a more healthful climate for collective bargaining. They do not, however, rule out the possibility of strikes. Union leaders are victims of their own political machines, and it is sad but true history that strikes have been called under more unfavorable circumstances, and it may happen again. The betting in Detroit nevertheless, is that strikes if they come, will be fewer and shorter than last year.

An interesting comparison can be drawn between the approach last year by the UAW-CIO in the General Motors negotiations and those currently in progress at Chrysler. Meetings between G.M. and the union began in early October, 1945, and by the 22nd of the following month, all G.M. plants were struck. Belligerency, militant attacks through the press, ultimatums, and a great deal of heat marked the negotiations. Chrysler negotiations began last year in late October, but progress, if any, was obscured by almost complete silence on the part of both sides. There has been no comment, no bids for public support, no strike votes or threats. On the whole, the negotiations have been quiet intermittent, and apparently inconclusive thus far. Both parties seem to be marking time.

Costs of Materials Continue to Rise Slowly

An analysis of what has happened since the removal of price controls to the price of goods automobile manufacturers buy shows a creeping upward trend in some basic materials and component parts. Lead and copper almost immediately rose in price and then leveled off at about the world level. However, since then lead has taken another boost, so that today it is at least 50 per cent above the level prevailing under OPA. About mid-December, steel companies raised the price of steel sheets and strip by $1 to $3 a ton. Other items that have increased are copper wire, 18 per cent; paint, up to 19 per cent; fractional horsepower motors, 25 per cent; brass stock for screw machine products, 20 per cent; rubber goods, up to 18 per cent; gray iron castings from 8 to 37 per cent; electrical equipment from 10 to 30 per cent, and crankshafts, 12 per cent. Undoubtedly these heavier costs had much to do with recent price increases by all passenger car manufacturers except Ford and Packard, but there is no indication of a further boost in car prices in the immediate future, unless wage increases are won by organized labor.

Available Information Indicates Minor Change in 1947 Models

A check with automotive companies in late December bears out the general advance information that differences between 1946 and 1947 models are to be almost negligible. Packard made no appearance changes at all, merely indicating the model year by a change in serial numbers. Pontiac will have only a few slight changes in sheet metal work as will Chevrolet. Oldsmobile had indicated that there will be relatively little appearance change. Buick also will confine modifications to grille treatment and other minor alterations. Hudson is making some changes in ornamentation, and Studebaker is making no changes at all. Nash has merely altered ornamentation slightly. Chrysler has not commented on model changeover, but it is believed that differences there will be very minor in all lines. Ford has not indicated just how far it will go in changing from 1946 to 1947, but the general opinion is that the company will follow the industry trend and make only minor modifications.

Increase in Freight Rates Raises Retail Prices of Cars

The most obvious and easily computed effect of the increased freight rates, ranging from 17 to 25 per cent, is on the delivered price of the vehicle. Ford estimates that the added transportation charge will increase the price of Ford, Lincoln, and Mercury cars by $1.78 at close-to-factory locations to as high as $23.79 on the West Coast. However, the factory list price is to remain unchanged, which indicates that the manufacturers will absorb at least for the present, the added cost imposed on higher freight rates on parts and materials used in manufacture. How much this will raise costs percentagewise is very difficult to compute, and no company was willing to make an estimate. However, it is an element of increased expense added to others of recent origin and will reduce the profit margin

(*Turn to page* 52, *please*)

Publications Available

Publications listed in this department are obtainable by subscribers through the Editorial Department of Automotive *and* Aviation Industries. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Seam-Type Bushings, Bearings and Spacer Tubes

National Formetal Co., Inc.—New catalog on seam-type bushings, bearings and spacer tubes that provide many special features because of their method of fabrication. Bronze, brass and steel bushings, bearings, etc., are illustrated in color, with detailed descriptions and measurement. There are several pages of tabular information which include applications of popular bushing and bearing alloys; material specifications; tolerances, groove patterns; spacer tube sizes and ordering information.

Laminac Resin

American Cyanamid Co., Plastics Div.—4-page folder on the use of Laminac Resin as a sealant for porous metal castings. It indicates the advantages of this polyester resin for sealing micro-porous flaws in castings, as well as providing a surface film to prevent steam corrosion. Methods of impregnating castings with Laminac resin are described in detail and are illustrated by schematic drawings.

Protective Coatings Products

Hercules Powder Co.—The numerous products used in the manufacture of protective coatings are conveniently listed, according to use, in a new four-page folder. Products are listed under various types of protective coatings in which they are used. Brief descriptive matter explains why a specific product is used for indicated purpose.

Oil Dilution Calculator'

D. A. Stuart Oil Co.—A new calculator called a Dilut-O-Graph is available for the purpose of computing quantities when mixing or diluting oils. It is a circular calculator made of special composition board.

Welding and Cutting Products

Air Reduction Sales Co.—A new 64-page catalog on welding and cutting products. It is illustrated and divided into two sections, 1) oxyacetylene welding and cutting gases, equipment and supplies; and 2) arc welding machines, accessories and electrodes. Ten pages are devoted to specially compiled electrode price lists.

Toggle Clamps

Detroit Stamping Co.—32-page catalog contains detailed specifications of entire clamp line and illustrations of many applications. A section is devoted to data on arbor spacers, shims, shim and feeler stock and miscellaneous job stampings.

Gearflex Couplings

Farrel-Birmingham Co., Inc.—46-page bulletin describes various types of couplings for use in industrial and marine service. The bulletin is well illustrated with photographs, drawings and installation illustrations and describes coupling functions together with recommendations of the correct types for specific applications. Complete engineering data with ratings, dimensions and weights are also included.

Aircraft Cleaning.

Cee-Bee Chemical Co., Inc.—The company's newest methods for cleaning aircraft surfaces are described in a bulletin Aircraft Cleaning Process. It also includes condensed descriptions of the company's materials now being used for cleaning in aircraft reconversion, maintenance and overhaul.

Flame Cutting

Joseph T. Ryerson & Co.—Illustrated bulletin on flame cutting. It describes the company's facilities for producing plain and intricate shapes from steel plates. A number of typical flame cut sections are shown along with information regarding the use of irregular shaped steel plates in both production and maintenance work.

Brake Drum Lathes

Waddell Engineering Co.—Two Spindle and Single Spindle brake drum lathes are described and illustrated in a four-page folder which also includes drawings of the True-Arbor mounting manufactured by the company. A specifications table on both the Two Spindle and Single Spindle lathes is included.

Electronic Tube Data

Westinghouse Electric Corp.—Easy Guide to Electronic Tube Data is the title of a new data book on replacement tubes for electronic devices. It lists tubes according to class—Phototubes, Pilotrons, Thyratrons, Ignitrons, Kenatrons and Planatrons and gives all essential technical data on each tube. A separate index is arranged numerically by type number and tells the class to which each tube belongs, its warranty class and list price. An interchangeability chart shows the company's equivalent for competitive type numbers. A brief explanation of the five functions of electronic tubes and a detailed discussion of warranty policy is also included.

Helicopter Council Formed, Holds First Meeting

Formal organization of a Helicopter Council of the Aircraft Industries Association was announced recently by Lawrence D. Bell, chairman of the Council and president of the Bell Aircraft Corp.

The Council, composed of manufacturers of helicopters, held its first meeting in Washington, Dec. 17, for discussion of potential problems facing the new and rapidly growing industry and to formulate policies for the operation of the Helicopter Council.

The members of the Council advocated policies which will encourage conservative, proper and constructive use of the helicopter. A recognition of the need for limiting uses to utilitarian operation will be a basic policy of Council members, it was announced.

Present at the meeting were: Bell Aircraft Corp.—Lawrence D. Bell, Leston P. Faneuf, Walter T. Bonney, L. Welch Pogue and George Neal; Firestone Aircraft Co.—Roger S. Firestone, R. H. Isbrandt, R. V. Guelich and J. P. Perry; Kellett Aircraft Corp.—W. Wallace Kellett and L. L. Douglas; McDonnell Aircraft Corporation—Lawrence E. Williams; Sikorsky Aircraft—B. L. Whelan and E. M. Benham; and Aircraft Industries Association—John E. P. Morgan, Joseph T. Geuting, Jr., William G. Key and I. C. Peterson.

Antique Automobile Show

The Veteran Motor Car Club of America will hold an antique automobile show in Horticultural Hall, Boston, Mass., Jan. 24 to 28, 1947.

Larger Model Unveiled by Bendix Helicopter

This is the new Model J Bendix helicopter, one of six four-place machines now being produced at the Stratford, Conn., plant of Bendix Helicopter, Inc., a wholly independent company, for ground and air testing and production planning. The Model J is powered by a 450-hp Pratt & Whitney engine.

PERSONALS

Recent Personnel Changes and Appointments at the Plants of Automotive and Aviation Manufacturers and Their Suppliers.

Packard Motor Car Co.—**James H. Marks**, Executive Vice-President, has resigned.

General Motors Corp. Detroit Diesel Engine Div.—**John C. Campbell**, Mgr. of Industrial Engine Sales, and **James W. Brown**, Advertising Mgr.

Auto-Lite Battery Corp.—**H. E. Hawley**, appointed Eastern Division Manager, with headquarters in New York City. **H. H. McCartney**, appointed Western Division Manager, with headquarters in Oakland, Cal.

Vickers, Incorporated—**Russell G. Hatton**, Aircraft Sales and Application Engineer.

Curtiss-Wright Corp. Export Sales Div.—**R. S. Huested**, appointed to sales staff.

Wright Aeronautical Corp.—**John T. Wetzel**, Assistant to the General Manager in charge of public relations and special assignments.

United Specialties Co.—Officers elected as follows: **John T. Beatty**, Pres.; **A. Vander Meulen**, Vice-Pres. and Treas.; **H. G. Chandler**, Vice-Pres. in charge of Sales; **J. C. Pickel**, Vice-Pres.; **B. H. Fretz**, Sec. and Asst. Treas.; **G. M. King**, Asst. Sec.

Vanadium-Alloys Steel Co.—**Francis B. Nimick** elected a director to fill vacancy created by death of T. H. Childs.

Tucker Corp.—**Lee Treese**, Vice-Pres. in charge of Manufacturing.

Devoe & Raynolds Co., Inc.—**Frank J. Soday**, Research Director at Central Research and Product Development Laboratories.

Ford Motor Co.—**Charles T. Ellis**, Director of all purchases of paint, paint raw materials, petroleum products, pigments and oils for the company.

Ford Motor Co.—**R. S. McNamara**, Asst. Director of Planning. **William Burnett**, head of newly created experimental section of Ford Engineering Dept. **Thomas A. Farrell**, Vice-Pres. of newly formed Dearborn Motors Corp.

Ampco Metal, Inc.—**Oscar Frohman**, General Sales Engineer.

Bellevue Industrial Furnace Co.—**Gerhardt Bertz**, Works Manager.

Gamble-Skogmo, Inc.—**George Glevis**, Director of Advertising.

Parker Appliance Co.—**S. E. Voran**, Advertising Manager.

General Electric Co.—Apparatus Dept., Meter and Instrument Div., **Richard Cutts, Jr.**, Asst. Mgr.; **E. J. Boland**, Mgr., Sales for Instrument Section; **E. J. Wehrle**, Consultant of the Instrument Section.

General Electric Chemical Dept., Metallurgy Div., **Ernest E. George**, Engineer.

The B. F. Goodrich Co.—**Edward J. Lewis**, Asst. to Manager of passenger car tire sales.

Trippe Manufacturing Co.—**B. O. Tobin**, General Sales Manager.

Towmotor Corp.—**Lee C. Daniels**, Chief Engineer.

Federal Electric Products Co.—**W. H. Lantz, Jr.**, Vice-Pres. and executive head of the Hartford Division; **Rey F. Frenger**, Vice-Pres. in charge of Wm. Wurdack Div. of St. Louis.

Michigan Steel Tube Products Co.—**Harry J. Longeway**, Comptroller, has been elected to the Board of Directors and named Secretary-Treasurer.

Curtiss-Wright Corp., Airplane Div.—**C. C. Pearson** has been named General Manager.

Aspin Rotary Valve Engine to be Built in the U. S.

Fox Manufacturing Corp., Mystic, Conn., will shortly be manufacturing rotary valve engines under license of F. M. Aspin & Co., Ltd., Bury, Lancashire, England. The Aspin rotary valv engine was described in the Nov. 15, 1944 issue of AUTOMOTIVE AND AVIATION INDUSTRIES, page 26. It features a single cone-shaped valve for each cylinder, and is said to operate at high compression ratios without detonation.

CALENDAR

Conventions and Meetings

SAE Annual Mtg. & Eng. Display, Detroit .....Jan. 6-10
Natl. Assoc. of Eng. & Boat Mfrs. Motor Boat Show, New York City, Jan. 10-18
Truck-Trailer Mfrs. Assoc. Annual Convention, Memphis, Tenn.....Jan. 13-14
Natl. Materials Handling Exposition, Cleveland .....Jan. 14-17
Veteran Motor Car Club of America Antique Auto Show, Boston.....Jan. 24-29
New York Aviation Show, Grand Central Palace, New York City.....Feb. 1-8
Amer. Soc. for Testing Materials—Spring Mtg., Phila. .....Feb. 24-28
Amer. Society for Metals, San Francisco .....Mar. 22-27
Midwest Power Conference, Chicago, Mar. 31-Apr. 2
Nat'l Assoc. Corrosion Engineers National Convention, Chicago...April 7-10
Amer. Society for Testing Material, Annual Mtg., Atlantic City..June 16-20

1946 Motor Vehicle Factory Sales

From U. S. Plants
(Automobile Manufacturers Association)

	Passenger Cars	Trucks	Buses	Total
January	56,367	44,994	467	101,828
February	57,784	34,914	265	92,963
March	85,810	37,636	527	123,973
April	132,631	80,762	948	214,341
May	166,942	75,373	789	243,104
June	141,090	60,038	774	201,902
July	209,180	87,454	862	297,496
August	247,261	97,881	1,067	346,209
September	232,280	95,658	833	328,771
October	283,586	107,154	975	391,715
November	269,081	100,892	1,146	371,115
Total—11 Months..	1,882,012	822,756	8,653	2,713,421

Factory Sales to Domestic and Foreign Markets

	Passenger Cars		Trucks		Buses	
	Domestic	Foreign	Domestic	Foreign	Domestic	Foreign
January	53,441	2,926	37,931	7,063	436	31
February	54,111	3,673	26,708	8,206	230	35
March	80,239	5,571	29,095	8,541	443	84
April	125,765	6,866	62,520	18,242	854	94
May	158,344	8,598	59,947	15,426	741	48
June	131,284	9,806	50,247	9,791	751	23
July	195,158	14,022	72,008	15,446	833	29
August	229,083	18,178	78,283	19,598	867	200
September	218,645	13,635	77,477	18,181	758	75
October	263,236	20,350	88,195	18,959	923	52
November	250,379	18,702	79,101	21,791	1,102	44
Total—11 Months.....	1,795,685	122,327	661,512	161,244	7,938	715

Motor Truck Factory Sales by Gross Vehicle Weight

From Plants Located in United States

Month	TOTAL 5000- Less	5,001- 10,000	10,001- 14,000	14,001- 16,000	16,001- 19,500	19,501- 26,000	Over 26,000	Tota
January	18,535	3,877	9,058	8,499	1,607	2,136	1,282	44,994
February	13,758	3,100	9,436	4,624	1,151	1,760	1,085	34,914
March	16,821	2,002	8,451	7,791	411	1,223	937	37,636
April	26,925	5,013	29,795	14,669	1,711	1,691	958	80,762
May	26,209	5,833	22,884	15,635	2,002	1,729	1,081	75,373
June	32,890	4,795	12,754	5,555	1,556	1,469	1,019	60,038
July	30,617	7,125	23,214	21,572	2,259	1,753	914	87,454
August	34,987	6,744	28,281	23,189	1,853	1,858	969	97,881
September	32,581	9,188	28,565	20,196	1,984	1,919	1,225	95,658
October	35,921	14,745	26,659	21,754	2,911	2,685	2,479	107,154
November	30,483	12,424	22,971	27,438	3,377	2,878	1,321	100,892
Total—11 Months....	299,727	74,846	222,068	170,922	20,822	21,101	13,270	822,756

Engineering Library

Strike-Harassed Industry Produced 65,800,000 Tons of Steel During 1946

Although major strikes interfered with steel operations in six months of 1946, the nation's steel mills succeeded in producing about 65,800,000 net tons of steel during the year, according to Walter S. Tower, president of American Iron and Steel Institute. That amount of ingots and steel for castings exceeded the output of any year prior to 1940, in which year war influences were strongly at work. If it had not been for the national steel strike and two coal miners' strikes, the industry doubtless would have produced more than 80 million tons of steel, and would have operated at close to 90 per cent of its annual capacity.

If 1947 witnesses another series of major strikes, then shortages of steel will be prolonged despite the best efforts of the industry. But, if operations are strike-free, enough steel can be turned out to restore within a few months a balance between supply and demand for steel. Consuming industries have the benefit of an annual steel capacity of nearly 92 million tons, that is, some 6,700,000 tons larger than in 1941 when many production peaks in the manufacture of consumer goods were established despite heavy shipments of steel for armament purposes.

Members of the steel industry are expecting to spend millions of dollars in 1947 to expand and improve their finishing mill facilities. In 1946, some $327 million was earmarked for this purpose by steel companies. An important part of this program will be the enlargement of the industry's facilities to turn out sheet and strip, two products widely used in the manufacture of consumer durable goods. In 1946, the industry's sheet and strip steel finishing capacities was one million tons larger than in 1941, and 2,500,000 tons in further additions were planned to come into operation in 1947.

The 1946 production of steel ingots and castings at about 65,800,000 net tons was almost 14 million tons below the 79,701,648 net tons produced in the preceding year. Steel mill operations in 1946 were at an average of 71.6 per cent of capacity during the year, compared with 83.5 per cent in 1945. However, 1946 operations rose and fell sharply as efforts to push steel production to top levels were hampered by repeated strikes, with the high for the year, 91.4 per cent of capacity operations, established in the week of Nov. 18, and the low, 5.1 per cent, established in the week of Jan. 21 during the industrywide steel strike.

Steel workers lost many millions of dollars in pay during 1946, as a result of the steel strike and the two coal miners' strikes. Thus, total industry payrolls came to approximately $1,500,000,000 for 1946, down 9 per cent from the 1945 total of $1,645,332,700, although the average hourly rate paid to steel-workers in 1946 was at an all-time record high. The monthly pay in September for steel mill workers was at the average rate of 136.2 cents per hour.

The pay increase granted in early 1946 to steel mill workers, 18.5 cents an hour, was only one of a number of boosts in operating costs during the year. In addition, prices of iron ore, coke, fuel oil, and equipment and machinery are higher, and railroad freight rates have been increased substantially since July 1, 1946. Railroad freight costs are a considerable factor in steel operations, due to the enormous amounts of raw materials that must be brought to the steel mills to permit operations. For example, in 1945, the steel industry had to bring in to steel plants more than 91 million tons of iron ore, 84 million tons of coal, 17 million tons of purchased scrap, and almost 6 million tons of fluxes.

America's Rubber Output At All-Time High Level

America's rubber industry operated at an all-time high level of production in 1946. Total rubber consumption topped a million tons for the first time, with about 73 per cent of that amount being American-made rubber.

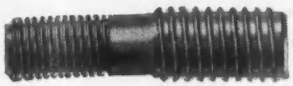
Best available statistics indicate that there will be no surplus of crude rubber at least through the coming year, according to John L. Collyer, president, the B. F. Goodrich Co. Rubber officials of the world's leading rubber-producing countries estimate total world consumption of rubber in 1947 at 1,700,000 tons, whereas total production of crude is expected to be only 1,200,000. Man-made rubber of course can and will make up the difference. It should be noted that for the year 1946 man-made rubber accounted for about 60 per cent of the total tonnage of rubber used in the world, not quite so high a proportion as the 73 per cent contributed by American-made rubber to this country's total use.

Probably by the middle of 1947 the supply of passenger-car tires will be, barring unforeseen disturbances to production, in a fair state of balance with respect to demand. Even though total rubber consumption is likely to be less in 1947, the total units of tires should be about the same as for 1946—about 87 millions—because a larger proportion of them will be passenger-car tires. Of the expected 1947 total, probably 70 to 72 million will be for passenger cars and about 12 million truck and bus casings, whereas the 1946 totals are expected to be 66,700,000 passenger-car tires and 15,500,000 casings for trucks and buses. The remainder of the 87-million units total is accounted for by farm service, airplane, pneumatic, industrial, and motorcycle tires.

1947 Nash

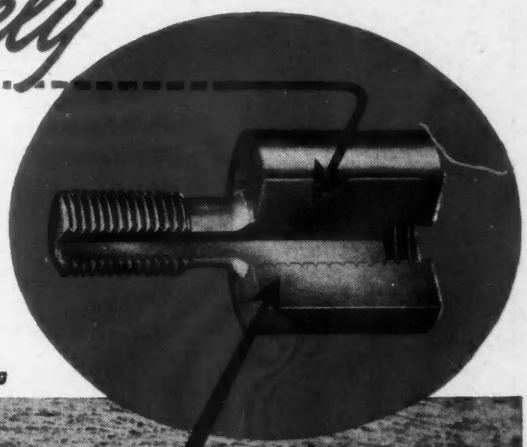
The 1947 Nash has been redesigned to give added front-end massiveness and a longer, lower appearance. Now in production, Nash's new "600" and Ambassador cars will be available in several body types. According to a company announcement, only minor changes have been made. New tooling of the instrument panel and two-tone treatment of interior hardware trim are among the minor changes.

THIS STUD *locks securely*



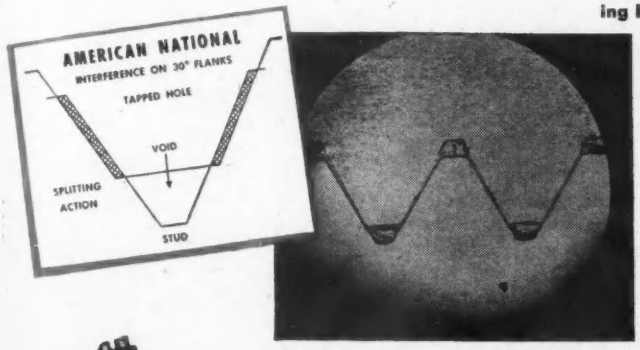
IT'S THE NEW LOK-THRED

MADE BY "NATIONAL"



Patent Pending

Photomicrograph of thread section in placd in aluminum, showing how 6° root angle in Lok-Thred design absorbs the load.



Photomicrograph of conventional stud thread (oversize fit in an attempt to lock).

Here's an entirely new principle of thread design—the LOK-THRED!

In conventional threads, stresses result in shearing or stripping action borne by the thread flanks.

The LOK-THRED design puts the load on the 6° angle at the root of the thread so that stresses are carried by compression transmitted to the surrounding metal.

The LOK-THRED is especially suited to studs for use in aluminum and magnesium as well as cast iron or steel. It solves the designer's age-old headache of studs loosening under vibration or lateral motion.

National
HEADED AND THREADED
PRODUCTS

FACTS ABOUT LOK-THRED

1. A modified American National thread designed to lock securely and become tighter in service.
2. Handled with standard tools.
3. Does not require selective fits.
4. Seals positively and in many cases obviates need for blind tapping and adding bosses.
5. Has much higher fatigue limit than ordinary threads.
6. Does not gall when being driven.
7. Does not fret from lateral motion.
8. Entire normal working load carried on 6° angle at root of thread.
9. Stronger in both tension and torsion than ordinary American National threads.
10. Re-usable and on any re-application one additional quarter turn brings the torque back to its original installation value.

Write for samples and full information

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Renewed advances in general business activity are indicated. The *New York Times* index for the week ended Dec. 7 stands at 136.6, as against 132.6 for the preceding week and 129.8 a year ago.

Sales of department stores during the week ended Dec. 7, as reported by the Federal Reserve Board, equalled 477 per cent of the 1935-39 average, as compared with 334 per cent in the week before. Sales were 19 per cent above the corresponding distribution a year earlier, as against a preceding similar excess of 3 per cent. The total in 1946 so far reported is 28 per cent greater than the comparable sum in 1945.

Electric power production increased slightly in the week ended Dec. 7. The output was 14.1 per cent above the corresponding amount in 1945, as compared with a like advance of 10.0 per cent shown for the preceding week.

Railway freight loadings during the same period totaled 729,084 cars, 10.3 per cent more than the figure for the week before but 6.1 per cent below the corresponding number last year.

Crude oil production in the week ended Dec. 7 averaged 4,694,750 barrels daily, 99,824 barrels less than the preceding average but 225,850 barrels above the comparable output in 1945.

Production of bituminous coal and lignite during the week ended Dec. 7 is estimated at 2,235,000 net tons, 9.0 per cent above the output in the week before. The total production in 1946 so far reported is 10.3 per cent less than the corresponding quantity in 1945.

Civil engineering construction volume reported for the week ended Dec. 12, according to *Engineering News-Record*, is $126,931,000, or 20 per cent above the preceding weekly figure and 88 per cent above the comparable sum in 1945. The total recorded for fifty weeks of this year in 131 per cent more than the corresponding amount in 1945. The increase in private construction is 187 per cent, and the rise in public construction is 77 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended Dec. 7 is unchanged at 139.1 of the 1926 average, as compared with 106.5 a year ago.

Member bank reserve balances increased $257,000,000 during the week ended Dec. 11. Underlying changes thus reflected include an increase of $211,000,000 in Reserve bank credit and a decline of $53,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $40,000,000 in money in circulation.

Total loans and investments of reporting member banks increased $58,000,000 during the week ended Dec. 11. An increase of $116,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $10,287,000,000, shows a net increase of $3,159,000,000 in twelve months.

News of the Industry

(*Continued from page* 47)

to some extent. An interesting fact is that about half the finished automobiles are shipped by rail. The manufacturers started working before the war to bring the percentage to about 70 per cent but were unable to reach that figure because of the freight car shortage. Back in the twenties, about 200,000 cars were available for automobile shipment, whereas today there are approximately 30,000 of the auto-loader type car available, with about 10,000 on order. However, the smaller number now in use are handled many times more efficiently, and under present traffic procedure the cars are returned in about 15 days for a new load of automobiles.

Automotive Industry Increases Use of Trucks for Short Hauls

Benefiting by its experience during the war, the automotive industry today is using truck shipments at twice the prewar rate for moving parts and materials within a range of 300 miles of the manufacturing plants. According to an AMA survey, the automotive manufacturers learned during the war to appreciate the flexibility of trucks in keeping pace with fast changing supply needs. One company now moves nearly everything within 300 miles by truck and averages about 400 inbound shipments a day, twice the prewar figure. It also began truck shipments from New England points during the war and has found it profitable to continue. The motor truck has been particularly valuable during the past year of shortages to pick up small-lot cargoes of parts vitally needed to keep the assembly operation going.

K-F Bonus Payment Reduced By Production Difficulties

When the $5 per car bonus plan was announced by Kaiser-Frazer Corp., it was expected that employes would collect about $1.5 million a year, based on production of 300,000 cars annually. The first year, however, the amount in the pool amounted to only $55,036 to be divided among 2783 eligible employes who had been on the payroll 90 days preceding Dec. 1 and who had not been absent more than 10 per cent of the working time. Largest check was for $41.82, with the average running $19.78. The small payment the first year was the result of production troubles which held output to 7,515 cars during the period up to Dec. 1. A payment of $1.25 per unit on 13,969 Rototillers also was included in the bonus. At the time the plan was announced union officials hailed it as the bright spot in the industry. Original projections estimated that it would raise the yearly income of K-F workers about 30 per cent above the industry average. Individual payments were computed by dividing the total number of man hours worked by the amount in the fund, and applying the factor to the number of hours each eligible employe worked. Only 63 employes were disqualified for being absent without good cause more than 10 per cent of the working time.

Only Three Makes of Foreign Cars being Imported into U. S.

Only three makes of foreign passenger automobiles are now being imported into the United States. They are: British Austin, manufactured by the Austin Motor Co., Ltd., Longbridge Wks., Northfield, Birmingham, and distributed in the United States by J. L. Green, Inc., 1920 Broadway, New York City; French Citroen, manufactured by Citroen, 143 Quai de Javel, Paris, France; and Italian Fiat, manufactured by Societa Anonimi, Via Nizza, 250 Turin, Italy.

Weekly Production of Cars and Trucks in U. S. and Canada

Week-ending		1946	Corresponding Week in 1941
Jan.	5	13,920	76,935
	12	23,340	115,935
	19	28,465	124,025
	26	29,410	121,948
Feb.	2	29,295	124,400
	9	23,785	127,675
	16	21,555	127,510
	23	19,410	127,740
Mar.	2	17,575	126,550
	9	23,050	125,915
	16	35,020	131,410
	23	37,285	123,805
	30	43,070	124,165
Apr.	6	47,735	116,255
	13	49,425	99,260
	20	57,565	99,945
	27	64,620	108,165
May	4	67,060	120,610
	11	71,335	132,380
	18	48,565	127,255
	25	53,020	133,560
June	1	31,895	106,395
	8	43,175	133,645
	15	50,206	134,682
	22	54,475	133,565
	29	60,015	127,926
July	6	45,175	96,457
	13	74,015	114,318
	20	80,395	109,912
	27	84,720	105,635
Aug.	3	79,385	62,146
	10	77,825	41,795
	17	88,990	45,550
	24	91,360	45,525
	31	74,960	39,965
Sept.	7	72,535	32,940
	14	88,888	53,165
	21	80,972	60,615
	28	86,582	77,035
Oct.	5	91,925	76,820
	12	86,330	79,065
	19	89,540	85,600
	26	87,680	91,855
Nov.	2	95,752	92,879
	9	92,760	93,585
	16	94,425	92,990
	23	96,461	76,820
	30	77,222	93,195
Dec.	7	93,907	92,205
	14	96,887	95,990
	21	95,940	65,875
Total		3,076,977	5,083,593

SPRINGFIELD MACHINE TOOL COMPANY

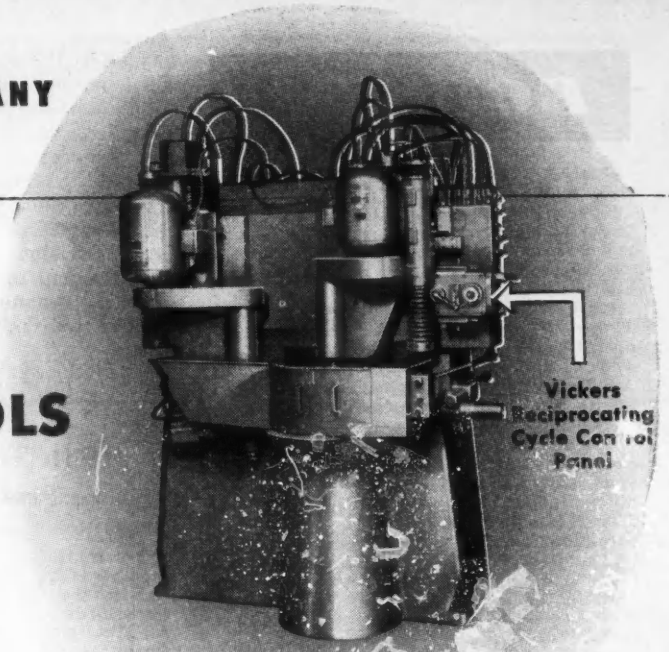
Uses

VICKERS

HYDRAULIC CONTROLS

to achieve

- INCREASED PRODUCTION
- BETTER WORK FINISH
- SIMPLICITY OF INSTALLATION
- VERSATILITY OF OPERATION
- PROTECTION OF MACHINE, WORK AND OPERATOR



Springfield Special Purpose Grinder

The manufacturer has utilized Vickers Hydraulic Controls on this special purpose grinder to provide an important increase in production, better work finish, simpler operation, and protection for the operator, machine and work.

The machine grinds the backface and bore of the ring gear in one setup. Each grinding wheel is reciprocated hydraulically in proper sequence. All phases of machine cycle operation are interlocked hydraulically to prevent damage to work and machine.

Vickers Reciprocating Cycle Control Panel provides smooth reciprocation of grinding wheel, thus providing better finish. Stroke lengths are adjustable and maintained accurately thus eliminating unnecessary and time-consuming overtravel for a specific setup. Adjustable speed hydraulic drive of work spindle makes possible the best combination of speeds for better finish.

Other Vickers Gasket Mounted Valves (in panel type assembly shown below) permit low cost installation and greater accessibility for adjustment and maintenance. They centralize hydraulic equipment for space saving and improved appearance . . . piping is simplified.

A Vickers Application Engineer will be glad to discuss with you how hydraulic controls can be used to advantage on your products. Get in touch with nearest office listed below.

This is one of a series of applications pointing out the many advantages of Vickers Hydraulic Controls.

VICKERS
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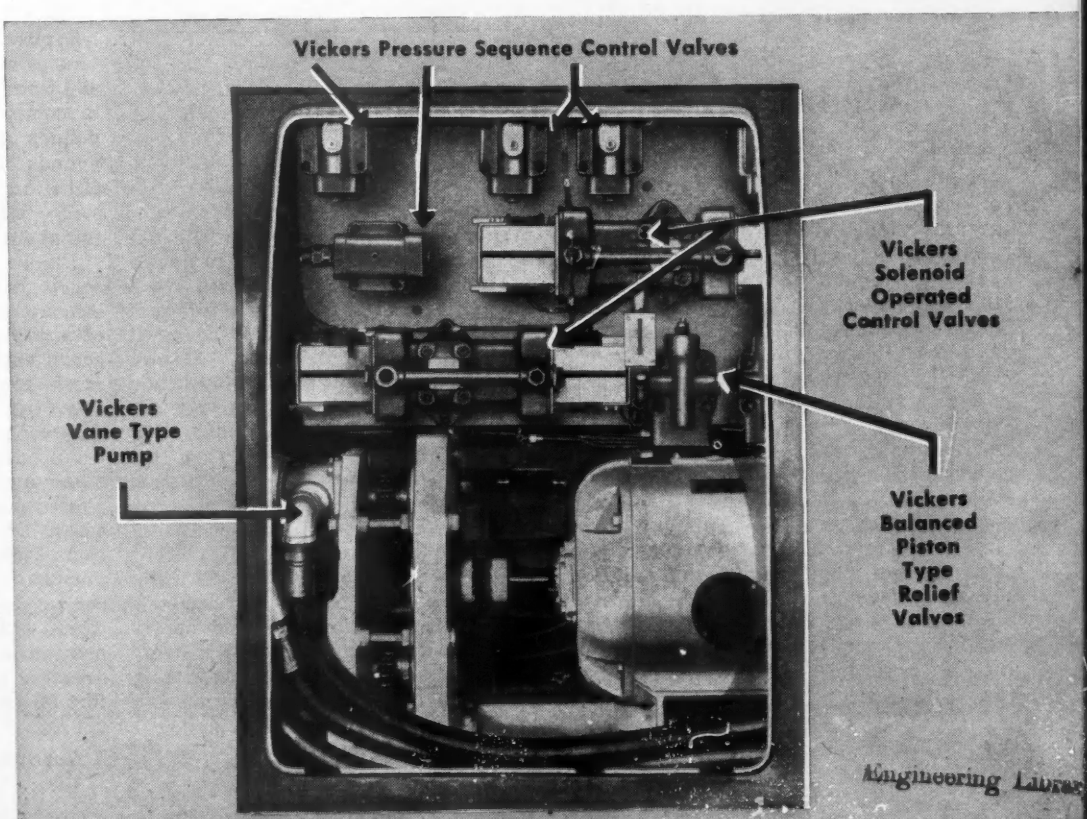
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921


Vickers Pressure Sequence Control Valves
Vickers Solenoid Operated Control Valves
Vickers Vane Type Pump
Vickers Balanced Piston Type Relief Valves

Rear View of Springfield Grinding Machine with Cover Plate Removed

Engineering Laura

BOOKS ...

JOINT A.S.T.M.-A.E.S. PUBLICATION ON ELECTRODEPOSITED METALLIC COATINGS. There has just been issued under the joint sponsorship of the American Society for Testing Materials and the American Electroplaters' Society a compilation of standard specifications and tests for electrodeposited metallic coatings. These two organizations have been cooperating for a number of years in research and standardization work. The A.S.T.M. activity in this field is carried out by its Technical Committee B-8 on Electrodeposited Metallic Coatings.

In the compilation are given specifications for various types of coatings on steel and non-ferrous metals—zinc, cadmium, nickel and chromium, and lead. There are requirements for nickel and chromium on copper and copper-based alloys and on zinc and zinc-base alloys, and there is a specification which covers chromate finishes on electrodeposited zinc (hot-dipped galvanized and zinc die-cast surfaces).

Two tests methods which have come into rather wide use are given, one covering salt spray testing (B 117) the other tests for local thickness of electrodeposited coatings (A 219).

The book is made more complete by the inclusion of two recommended practices, one pertaining to chromium plating on steel (B 177) the other preparation of low-carbon steel for electroplating (B 183).

Copies of this new 52-page publication, six by nine in., can be obtained from A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa., at $1.25 each. Special prices are quoted on orders in quantity.

Chandler-Evans Merged with Niles-Bement-Pond

Charles W. Deeds, president of Niles-Bement-Pond Co. of West Hartford, Conn., has announced that effective Jan. 1 the company's wholly owned subsidiary, Chandler-Evans Corp., would be merged with the parent company and be known as Chandler-Evans Division of Niles-Bement-Pond Co. This change in the corporate structure will in no way affect the operation of the business which is now located in its entirety at the plant of the parent company in West Hartford. B. H. Gilpin, vice president and general manager of Chandler-Evans Corp., will become vice president of Niles-Bement-Pond Co., and will continue as general manager of Chandler-Evans Division. M. E. Chandler, now vice president in charge of engineering, will become manager of engineering and research for the Division.

1946 Truck Trailer Production*

Vans	October	10 Months
Insulated	69	976
Refrigerated	481	1,927
Furniture	41	1,604
All other closed top	3,120	22,014
Open top	276	1,522
Total Vans	3,987	28,043
Racks		
Cattle Racks	430	3,886
Stake Racks	341	2,793
Total Racks	771	6,679
Tanks		
Petroleum	181	1,488
Other	84	601
Total Tanks	265	2,089
Pole and Logging		
Single Axle	742	4,978
Tandem Axle	152	1,226
Total	894	6,204
Platforms	1,433	9,360
Low-bed haulers (over 15 ton)	152	1,600
Off-highway	68	478
Dump trailers	155	572
All other trailers	428	2,037
Total All Trailers	8,153	57,062
Trailer Chassis	578	4,837
Total Trailers and Chassis	8,731	61,899

* Industry Division—Bureau of the Census.

Reorganized Salvage Department

(*Continued from page* 31)

on the assembly line is incomparably greater than tool repair cost.

Small tool salvage still is an important function at Ford. It is true that some operations have been dropped as unprofitable, but others are paying off well. It was found that butt welding short sections of broken drills, which was done during the war, no longer pays because of high labor cost in relation to replacement cost. It also is no longer profitable to resolder fire pots. Forging of high speed steel into tool bits also has been discontinued. Drills are reworked to the next lower size or are made into step drills by grinding down the pilot. Reamers are re-worked to the next lower size.

Ford has an interesting tool maintenance program on broaches, plug gages, locating bushings, arbors, female gages, and centers. When the wearing surface becomes worn, the chrome is stripped off to 0.0025 undersize, replated to about 0.0025 in. oversize, and then ground down to exact dimensions. Thus, the tool is never thrown away until it breaks. Rotary files also are reconditioned many times. Starting with a new blank 2½ in. thick, the salvage department cuts serrations 1/32 in. deep. When the file is worn, it is annealed, smoothed up in a Bullard, and then recut and rehardened. The process is repeated until the blank is down to ¾ in. thick. Cold chisels, drift pins, and locating punches are reforged and put back on the job. In addition to these operations, the salvage department has many other small tool jobs, such as fitting handles in all hammers, car movers, sledges, etc. When end wrenches spread, the jaws are closed up by forging, after which they are ground to original size. Spanner wrenches are repaired by replacing the lugs. Broken or cracked sockets are replaced. Some items are reworked for other purposes, such as shanks from a broken broach which are cut off square and used as tool bits.

Reclamation of used fire brick is another paying proposition at Ford. When furnaces are torn down, the brick is taken to a grinder where it is reduced to gannister which is used for mortar in building new furnaces and for lining ladles and runs. Not only does this effect a saving of about 50 per cent in the cost of gannister, but it eliminates the expense of hauling the used brick several miles to a dump. Waste oil is put through a reclaiming process and piped to furnaces in the steel mill. Even oil lying on the surface of the river is skimmed off and reclaimed. High speed steel milling cutters and other tools which no longer are serviceable are remelted for the company's own use, since the best price obtainable for scrap is only about half the price of new steel of the same quality, which runs several hundred dollars a ton.

In total, salvage is big business. In one month the Ford salvage department: furnished the open hearth furnaces with 24,828 tons of scrap carbon steel; provided the electric furnaces with 5042 tons of mixed carbon and alloy scrap; turned 8033 tons of scrap over to the production foundry; cut 117,000 pounds of shipping pads from damaged shipping cartons; supplied 132,000 pounds of copper scrap for use in cylinder blocks, camshafts, etc.; reclaimed 86,000 gallons of waste oil; fed 4372 tons of cleaned, baled steel to the furnaces; produced 845,100 pounds of ground gannister; reclaimed 16,100 pounds of babbitt and 24,000 pounds of lead; reclaimed and put in storage 220 tons of structural steel out of a total of 480 tons; repaired 507 batteries for use in company cars and produced 11,898 pounds of scrap lead. About 75,000 pounds of paper a day is collected and either turned over to the paper mill or sold. Used IBM cards alone account for about 11 tons of paper a month.

Plans for continued reduction in scrap handling costs are underway. Among them are possible installation of a paper baler in each building and a scrap baler at the end of the busheling steel conveyor to eliminate carting these materials to a central baling department.

An indication of the importance of scrappage and salvage is indicated by Ford's plan to set up a chart system on scrap costs. When completed the system should indicate accurately the amount of scrap generated for each car produced. It should also show just where the largest scrap costs are and provide some indication of where the greatest need lies for concentrated effort on cost reduction.

The CONE AUTOMATIC MACHINE COMPANY sees many GOOD THINGS AHEAD

It is reported that . . . . . .

Westinghouse calls its new steel encased motor the most revolutionary change in construction in 58 years and states that it delivers up to 134% more power per pound than previous motors.

get ready with CONE for tomorrow

Federal Telephone and Radio Corporation will conduct experiments with television, FM and radar in a building at Nutley, N.J., which will be completely shielded from atmospheric electricity.

be ready with CONE for today

Called the world's largest, a spot welder that can make 48 welds at a single stroke is in use at Pullman-Standard Car Manufacturing Co.

get ready with CONE for tomorrow

A division of Reynolds Metals Company has a new line of all-aluminum bicycles and scooters.

be ready with CONE for today

Raytheon Mfg. Co. has an electronic kitchen range. The food is put in a disposable dish and quickly cooked by the energy from a magnetron tube.

get ready with CONE for tomorrow

Bell Telephone Laboratories report that they have developed a tube that will send a hundred million words per minute by telegraph.

be ready with CONE for today

The Army Air Force has contracted with Fairchild Engine and Airplane Co. for fundamental research in the use of atomic energy in aircraft.

get ready with CONE for tomorrow

Aluminum Co. of America has recently supplied a 100-foot all-aluminum span for a railroad bridge at Massena, New York.

The Souhegan Mills of Wilton, N. H., believes that its molded board, made of shavings, can compete in price and utility with plywood or lumber.

be ready with CONE for today

The U. S. Bureau of Mines finds that Freon II is more effective in fighting gasoline fires than any of the other gases tested.

get ready with CONE for tomorrow

Patent 2,404,206 has been granted for a method of mining practically pure copper by dissolving it chemically and accumulating it electrolytically.

be ready with CONE for today

Nylon drive ropes are said by Plymouth Cordage Company to reduce machine shut-downs.

The behavior of piston rings and oil films has been studied by the National Advisory Committee for Aeronautics by using a glass engine cylinder.

get ready with CONE for tomorrow

When their new 2-million volt machine is installed, Babcock and Wilcox Co. will have 12 X-ray machines in use for checking steam generating equipment.

be ready with CONE for today

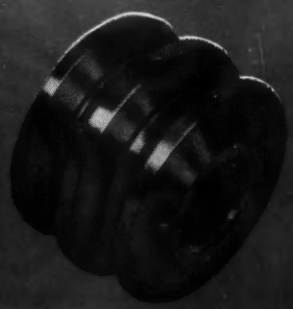
Blaw-Knox has built two 23-cubic yard clamshell buckets for unloading coal on Lake Superior. They weigh nearly 14 tons apiece and are believed to be the largest of their kind.

get ready with CONE for tomorrow

Scientific American prophesies that the use of silicones will bring about a revolution in surface finishes comparable to that resulting from the development of nitrocellulose lacquers.

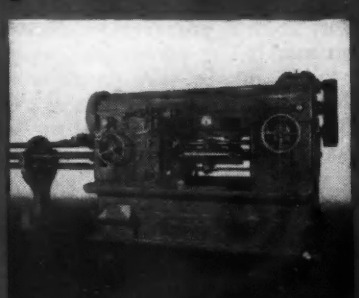
FOLLOW THESE PAGES FOR NEWS OF PROGRESSIVE PRODUCTION

Give soft jobs to *any* Automatic



put the *tough* ones on a CONE

From 65 mm 3312 stock, a 2⅜" Six Spindle Conomatic, with 13 HSS tools, produces the part shown here in 71 seconds.



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36

Abstracts of SAE Papers

(*Continued from page* 40)

a disturbance in the other. The response of the second control in correcting for this disturbance would create another disturbance in the first. This process could continue, with the disturbance being transferred back and forth between the two controls, resulting in badly under damped or even unstable operation of the system with both controls operating together, even though each, when operating alone, might produce stable operation.

The Future of the Gas Turbine in Air Transportation

By Franklin W. Kolk
American Airlines System

THE recently accelerated development of the gas turbine type of power plant, particularly in the turbine driven propeller or turbo-prop configuration, has led to widespread speculation as to the applicability of such a power plant to transport airplanes both in military and domestic service.

In the application of the turbo-prop to transport airplanes, certain inherent characteristics of this type of engine differ from those of reciprocating engines, the most important of which is the variation of fuel consumption with altitude and speed. The specific fuel consumption of turbo-prop engines decreases very rapidly with speed and altitude. This is completely the reverse of the characteristics of reciprocating power plants whose minimum fuel consumptions occur at low altitudes and low power outputs. Because the early turbo-props will be constructed with moderate compression ratios and moderate temperature ratings, fuel consumption will probably be quite high when compared to reciprocating engines unless full advantage is taken of speed and altitude. Therefore, the most important design characteristics of an airframe to be powered by turbo-props are extremely low drag and the lavish use of power for ability to operate at extremely high altitudes and speeds.

Present indications are that at 35,000 ft and 450 mph the fuel consumption of a turbo-prop with conservative design will approach that of a comparable turbo-supercharged reciprocating engine, although the fuel requirements at low altitude will be very much higher. Fuel reserve will probably impose some penalty on the turbo-prop because it must be based on low power operation at low altitudes. In fact, the indications are that the total weight of power plant plus fuel reserve will probably be as great or greater for this type of power plant as for the reciprocating engine. It might be pointed out, however, that as a matter of economics, fuel reserve is considerably less expensive to maintain than the same weight of engines, turbo-superchargers, intercoolers, exhaust ducts, and related apparatus.

One of the most uncertain factors in the operation of turbo-props is the cost and quality of the fuel required. Although these engines can be made to function on a wide variety of fuel, present development is based on the use of a gasoline type, usually standard high-grade aviation fuel. Initial development of turbo-jet engines, particularly in Great Britain, was based on the use of kerosene. Although kerosene has a relatively low cost and hence may be satisfactory as long as no severe quantity requirement is imposed, low-cost kerosene is a by-product. Too great a demand will increase the price. Kerosene has another disadvantage which may be serious for our purposes. Its pour point is so high that serious difficulties may be encountered with fuel solidification in flight. Therefore, kerosene appears to be a poor fuel for large scale use in turbojet and turbo-prop engines.

Automobile Compartment Heating

Automotive Space Conditioning

By E. T. Todd and F. O. Gadd
Engineering Division
General Motors Corp.

PASSENGER comfort is determined, mainly, by three conditions: temperature, odors, and visibility. Although these conditions may seem to be unrelated, their solution can be achieved by processing and distributing an adequate supply of fresh air through the use of a fuel burning booster heater.

Coach heating installations in the past have utilized engine heat in various ways, but the results have not been satisfactory because the engine does not reject enough heat under some design operating conditions. Heat is lost from a properly conditioned coach primarily by transfer through the walls and by the large volume of heated air which must be exhausted. The heat loss through the structure varies greatly with type of construction as well as with the weather.

Two per cent down grades and high tail winds occur with sufficient frequency and length of duration as to cause failure of the heating system and periods of passenger discomfort. To alleviate this condition, designers have resorted to recirculating the enclosed air to conserve heat, and to sealing the bodies to prevent infiltration of cold air. Recirculated air increases the amount of moisture in the passenger space beyond the saturation point because the occupants are giving off from one quarter to one third of a pound of moisture per person per hour, resulting in fogging and, in sub-zero weather, instantaneous frosting of the window glass.

Another by-product of inadequate heat is obnoxious odor. As recirculated air accumulates moisture, so does it gather organic matter, perceptible as odors. Because recirculation of air fails to pressurize the passenger space, engine fumes are not kept out where leakage exists between passenger and engine compartments.

A third evil inherent in recirculation

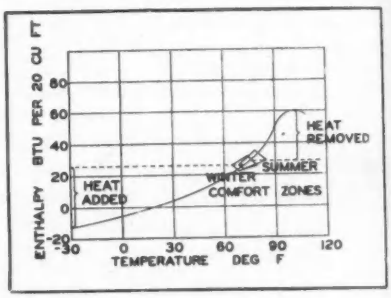

Fig. 14—Heat to be added or removed for comfort

of heated air is unsatisfactory temperature control. Regulation and compensation for extreme temperature changes are necessary because the heating load will vary with sudden changes in passenger load, solar heat, and power output. Even with thermostatic control, temperature regulation is limited to heat loss through the body structure. Temperature in the passenger space can be stabilized, odors and cold drafts can be eliminated, and window glass kept clear by supplying a minimum of 20 cu ft per min per passenger of fresh air to which the correct amount of heat has been added, prior to correct entry into the passenger space. Fig. 14 shows the amount of heat to be added to air in winter or subtracted from air in summer to obtain human comfort. The enthalpy of air has been calculated at —30 F and 80 per cent relative humidity and at 95 F and 51 per cent relative humidity for conditions obtained from design wet-dry bulb data for the United States.

The Janitrol liquid fuel burning heater, manufactured by the Surface Combustion Corp. for aircraft use during the war, was converted to a Diesel fuel burning unit with suitable con-

(*Turn to page* 58, *please*)

Rx for long life...

in anti-friction bearings, proper attention to lubrication is essential. With Torrington Needle Bearings efficient lubrication is almost automatically assured.

A drop or two as required...

may be the "prescription" for your application and often no additional lubricant is needed after the initial installation. For in Torrington *Needle* Bearings the lubricant *lasts* for a long period. Because the turned-in lips of the retaining shell provide a natural reservoir for oil or grease, an *extra margin* of safety is provided. This is another Needle Bearing feature that is contributing to their record of long service life and low in-use cost.

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trols for coach use. The basic principles of the aircraft heater were applied to a water-jacketed unit capable of burning either Diesel fuel or gasoline.

Fig. 15 shows the booster heater located on the engine side of a diversion valve. Water flow from the engine water manifold through a booster pump to the booster heater where heat is added at the rate of 75,000 BTU per hr when the heater is in operation. Flow is then to the heater core or directly back to the engine pump. The diversion valve is operated by the passenger space thermostat. When heat is not required in the passenger space, water from the booster heater is shunted back to the engine by the diversion valve. Thus, the engine or coach, or both, can be heated by booster heater.

In the GM transit coach installation the booster heater is located under the floor near the emergency door exit.

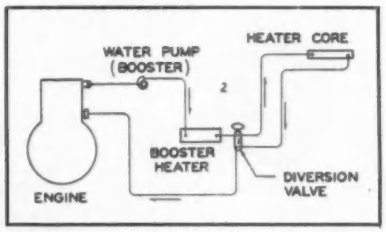


Fig. 15 — Schematic diagram of booster heater installation

Just above it on top of the floor is located the diversion valve and heater water pump. Water from the engine, after passing through the booster heater, flows to this diversion valve where it is directed to the front of the coach or shunted back to the engine, according to the passenger space thermostat requirements. Hot water flowing forward on demand of the thermostat, circulates through a heater core directly over the driver's head and from there returns to the intake side of the engine water pump. Air is taken in directly over the front windshields, forced through the heater core, and along ducts above the passenger windows on both sides of the coach. It is discharged outwardly through narrow slats and curves down over the windows and thence to the floor. The desired temperature of this air is maintained by a rapid and intermittent flow of hot water as regulated by the diversion valve which, in turn is operated by the passenger space thermostat. The thermostat is located in the front end of the coach, one element within and sensitive to duct temperature, and another element exposed and sensitive to passenger space temperature. The action of this thermostat is to increase temperature of air in the ducts as the passenger space temperature decreases, and, conversely, to decrease duct temperature as passenger space temperature increases. In extremely cold weather duct temperatures are maintained relatively high with the result that the ducts which extend from directly above the grab rail to the windows give off an appreciable amount of radiant heat. The outwardly discharging air from the ducts produces an inflow of surrounding air from the ceiling with the result that the same temperature is maintained substantially from ceiling to floor, and from front to rear. The continuous flow of heated dry air over all windows prevents fogging and frosting.

Heat and Sound Insulation

By L. M. Ball
Chrysler Corp.

THE selection of suitable thermal insulation involves such factors as:

1. Conductivity. The lightest material is usually the best, but from lightest to heaviest, the range of thermal conductivity is not greater than ±18 per cent. This suggests that the material be selected on basis of weight; the lighter, the better.

2. Weight and cost.

3. Fabrication. Often the selection of insulating materials is governed largely by the fabricating techniques which will be employed. Consideration should be given to the die cutting equipment used, the method of attachment, and effect of adhesives.

4. Compression. Ability of materials to recover nearly their original thickness is sometimes of great importance. Frequently insulating materials are piled in stacks 15 or 20 ft high and the bottom pieces should not come out only half as thick as they should be.

5. Moisture. Some insulating materials disintegrate if much moisture is absorbed. If the material is laminated, a water proof adhesive should be employed when there is danger of moisture absorption. Also, thought should be given to the possibility of mildew and rotting.

6. High Temperature. Some of the organic insulating materials are apt to char at temperatures of 300 F or less. This must be taken into account and also the fact that some materials give off very unpleasant odors when heated.

7. Staining. When insulating material is to be used in contact with cloth trim, it is well to make sure that the material does not contain ingredients which will stain the cloth.

8. Rats. Insulating materials for automotive use should be made of something that rats and insects don't like.

In keeping heat out of automobile and truck bodies, four items are of primary importance: thermal insulation of the dash and floor; sealing against infiltration of underhood air; provision of abundant ventilating air; and shielding against radiation from the exhaust system. Thermal insulation in the roof is of value only in combination with means for heating or cooling the inside air.

In sound insulation the best and most obvious means of eliminating noise is to reduce the disturbance at its source. Mechanical elements which produce but little noise directly may transmit vibrations to remote parts of a complex structure where some comparatively large area may be caused to vibrate and thus radiate a considerable amount of acoustic energy. Such disturbances can often be greatly reduced at the source by better balancing of rotating parts, reduction of clearances in reciprocating parts, and general improvement in the excellence of mechanical design and construction. Usually these possibilities should be exhausted before recourse is had to other means of acoustic treatment.

When it is impractical to further reduce vibration inherent in some mechanical device, it may be possible to reduce vibrations transmitted to other parts of a connecting structure by means of resilient mountings. In some cases, vibration at resonance can be partially neutralized by the addition of a small spring mounted mass tuned approximately to the resonant frequency. Under ideal conditions the small mass will vibrate out of phase with the main mass and thereby introduce forces which tend to offset the vibrational force at resonance. Such a device is often of great benefit as, for example, in reducing resonant torsional vibration in crankshafts.

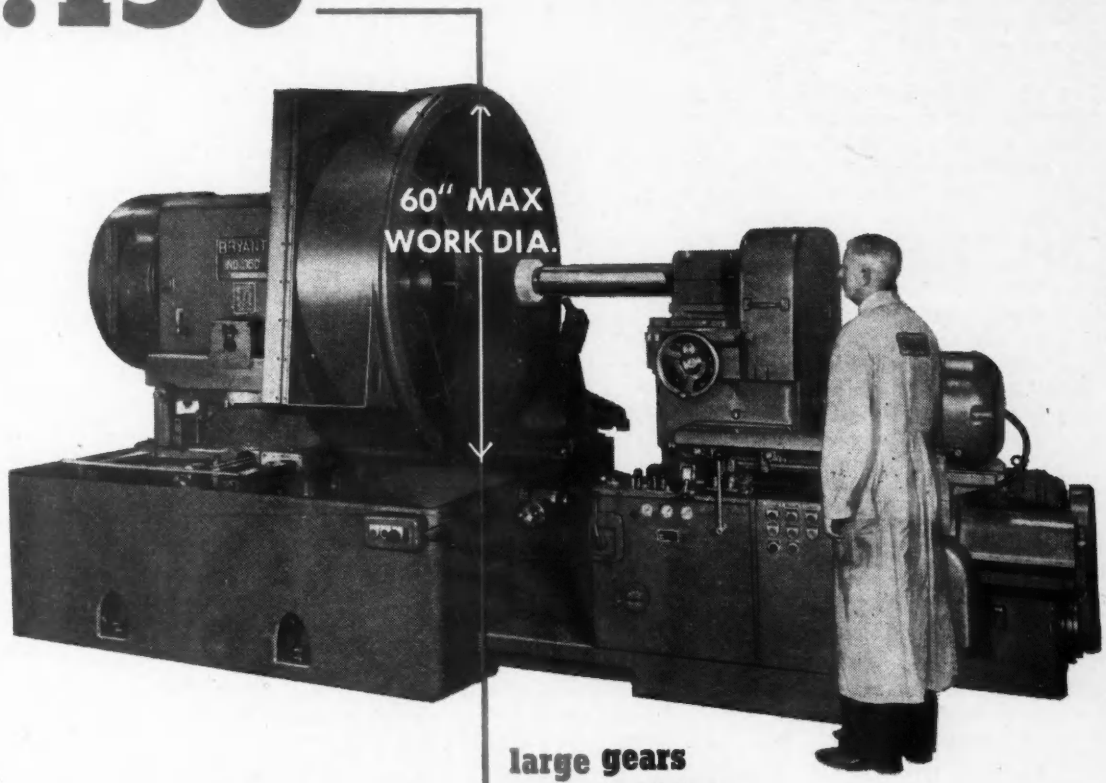
Frequently small vibrations may be present throughout a complex structure without creating any serious disturbance, but if some part of the structure, such as a large thin flat panel, happens to be in resonance with one of the vibrations, then excessive amplitudes may be built up. In cases of this kind, sound deadening materials may be applied to the offending sheet metal areas. The most effective practical deadeners are fluid compounds of asphalt containing heavy fillers such as sand or limestone. The mixture is applied with special spraying equipment and when allowed to dry, preferably in an oven. In automotive applications, the weight of such treatment is usually about one-half lb per sq ft. Heavier coatings are apt to give trouble from sagging or dripping of the material immediately after spraying. This type of treatment is used extensively in doors to keep them from ringing when they are slammed. Much of the tinny sound is suppressed making the door sound more solid and expensive.

Sheets of felt saturated with asphalt are effective deadeners and may be used very conveniently on metal doors. The asphalt impregnation is mostly responsible for the deadening value, but also makes the felt more waterproof and durable. Unfortunately, the asphalt increases the density of the felt enough to render it practically worthless as a thermal insulator.

One of the most effective ways to reduce the disturbance created by a source

(*Turn to page 60, please*)

NEW No. 150 HYDRAULIC INTERNAL GRINDER



Another Bryant Postwar Development for

large gears
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large dies, etc.

The new No. 150 grinder is a great Bryant postwar achievement to vastly increase the internal grinding capacity of your plant. This big machine is easily controlled and produces the finest finish on gears, bushings, castings, etc., *up to 60" in diameter.* The many functional features of the new No. 150 assure extremely accurate work on a high production basis. The famous Bryant three point wheel slide suspension is basic and closely maintains wheel alignment at all times. A preloaded anti-friction cross-slide insures smooth hand and power cross feed, and a hydraulically retractable wheel slide simplifies the loading and unloading of parts. The work spindle is designed for the mounting of work fixtures on either end, and is hollow to facilitate the chucking of special spindles or long work.

In a single chucking, the new No. 150 can grind a bore, or a bore and face—the bore may be either straight or tapered. When grinding a face and straight bore the new No. 150 is particularly advantageous because it assures maintenance of squareness between bore and face. Outside diameters, or outside diameters and faces can also be finished in one chucking. A copy of the new catalog sheet giving full details is yours for the asking.

If you have internal grinding work in the range from 1/16 inch diameter bore to 60" diameter swing, Bryant has machines that will economically meet your requirements. It will pay you to—

Send for the man from Bryant.

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of sound is to enclose it in a soundproof box, as heavy as possible and as complete as possible. A good enclosure can be slightly improved by lining the inside with sound absorbing material, but the improvement seldom justifies the expense. It is much more practical to use a slightly heavier enclosure. Of course, if the sound level inside the enclosure is of importance, as it might be, for example, in the engine room on a boat, where men must be in attendance, then absorbing material is of value.

A very important factor in the effectiveness of an enclosure is its completeness, that is, its freedom from openings through which sound may leak out. Openings amounting to only a few per cent of the total area destroy the effectiveness of a good enclosure. For this reason, great effort is made to seal all cracks and holes in the dash and front floor in automobile bodies in order to keep out as much engine noise as possible. Improving the quality of sound insulation materials in the dash liner is of little value unless the holes have first been well sealed.

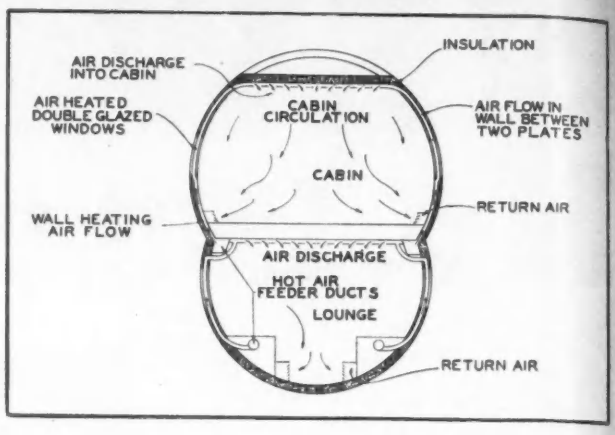


Fig. 17—Heating system for two deck airplane

Fresh Air Automotive Heating

By Lewis A. Rodert
South Wind Division
Stewart-Warner Corp.

AN EXAMINATION of the heating problem in automotive vehicles indicates that further improvement is necessary and that this improvement probably will have to come from the use of systems more unique and ingenious than rearrangements of the simple recirculating type heating system. An examination of the heating systems in several of the new commercial air transports shows a most advanced state of vehicular heating and ventilation, and gives clues to possible future trends in automotive heating.

The quantity of heat, volume of circulated air, and pattern of circulation are dependent upon each other and also upon the following factors:

1. Volume occupied per passenger.
2. Leakage of air through cracks.
3. Area of window glass to be kept free from water precipitate.
4. Average temperature of the radiation environment.

The maximum quantity of heat which must be provided is also affected by the average minimum ambient air temperature, the average maximum operating speed, and the thermal insulation of the vehicle.

The cabin air circulation arrangement of an airplane heating system is illustrated in Fig. 16. About 28 cfm of fresh air per passenger is provided at low cruising speed. Each passenger occupies 45 cu ft of cabin space. About 65 per cent of the air is passed through a double wall and window arrangement.

The heated air enters the cabin from supply ducts at the floor level on both sides of the fuselage. All of the circulated air rises in the cabin from the air inlets to the exhaust louvers which are at the top and rear of the cabin. A large number of air outlets are used in order to avoid local high velocities and a feeling of draftiness. The windows of the passenger cabin are kept free of water precipitation by the passage of heated fresh air between two glass panes which form the window panels. Ice prevention on the outside as well as fog prevention on the inside of the pilot's windshield is accomplished in a like manner although the heating intensity is greater for the windshield. The quantity of ventilated air varies slightly with the velocity and altitude of the airplane. The quantity of heat supplied is determined by the internal temperature and modulated by the ambient air temperature.

The circulation of air in another airplane heating system is illustrated in Fig. 17 which shows a section of a two deck airplane fuselage. About 30 cfm of air per passenger is passed through the cabin. Of this quantity 10 cfm is fresh air, the remainder is passed through a filter and purifier before recirculating in the cabin. Each passenger occupies about 55 cu ft of cabin space. All of the circulated air is passed through the walls and double glazed windows from plenum chambers at the floor levels to ceiling outlets. The outlets are perforated plates which cover almost the entire ceiling. It is expected that no local high air velocities will exist and that the cabin will be completely free from drafts. The precipitation of water on the cabin windows is avoided by the circulation of heated air between the double glass panels. The formation of ice or fog on the pilots' windshield is to be prevented by the use of an electrically heated glass panel. An electric conducting transparent film is applied to the plastic binder of the safety glass windshield, thus producing a panel which may be heated without the visual obstruction of embedded wires in the glass.

In a third airplane heating system, all of the air is passed through a floor, wall and window heating arrangement, starting from a plenum chamber at the center of the floor and extended to louvers which are located above the passengers. The circulation of air in the cabin is downward over the occupants and is exhausted at the floor level through louvers on the walls. Water precipitations on all windows and pilot's windshields are prevented by the flow of air between double glass panels. When all of the seats are occupied, the volume of circulated air is 16 cfm per passenger.

All of the new systems employ multiple air outlets which will give uniform air temperatures throughout the passenger space. By heating the walls and windows, the mean radiation temperature of the environment is raised and comfort is possible with a lower circulated air temperture. This feature is desirable because when heating comfort is established at a low air temperature, the occupants are more refreshed and

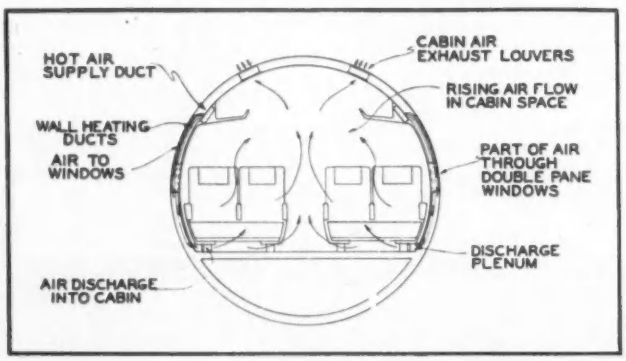
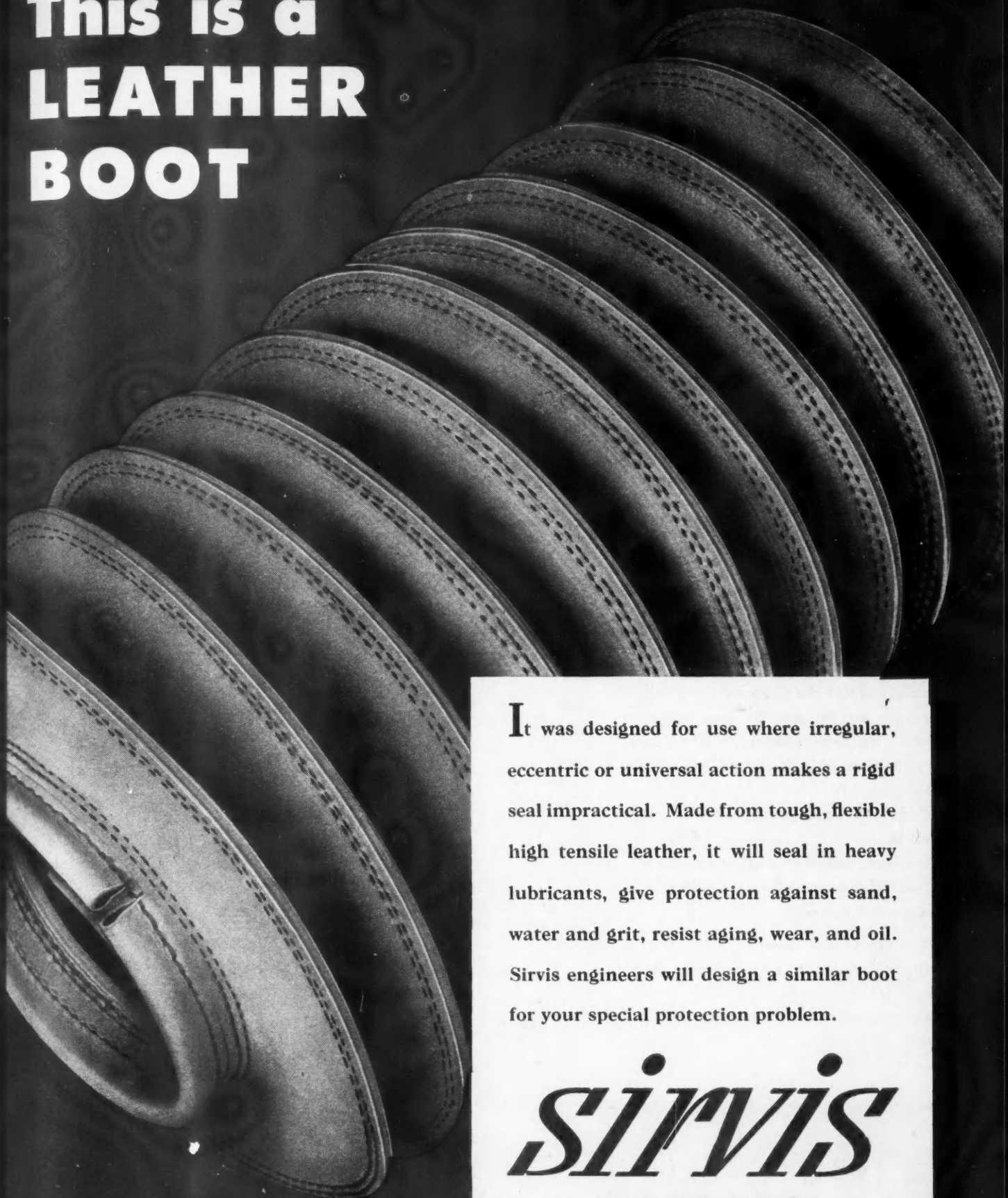

HOT AIR SUPPLY DUCT
CABIN AIR EXHAUST LOUVERS
RISING AIR FLOW IN CABIN SPACE
WALL HEATING DUCTS
AIR TO WINDOWS
PART OF AIR THROUGH DOUBLE PANE WINDOWS
DISCHARGE PLENUM
AIR DISCHARGE INTO CABIN

Fig. 16—Airplane heating system utilizing double wall and window arrangement

This is a LEATHER BOOT



It was designed for use where irregular, eccentric or universal action makes a rigid seal impractical. Made from tough, flexible high tensile leather, it will seal in heavy lubricants, give protection against sand, water and grit, resist aging, wear, and oil. Sirvis engineers will design a similar boot for your special protection problem.

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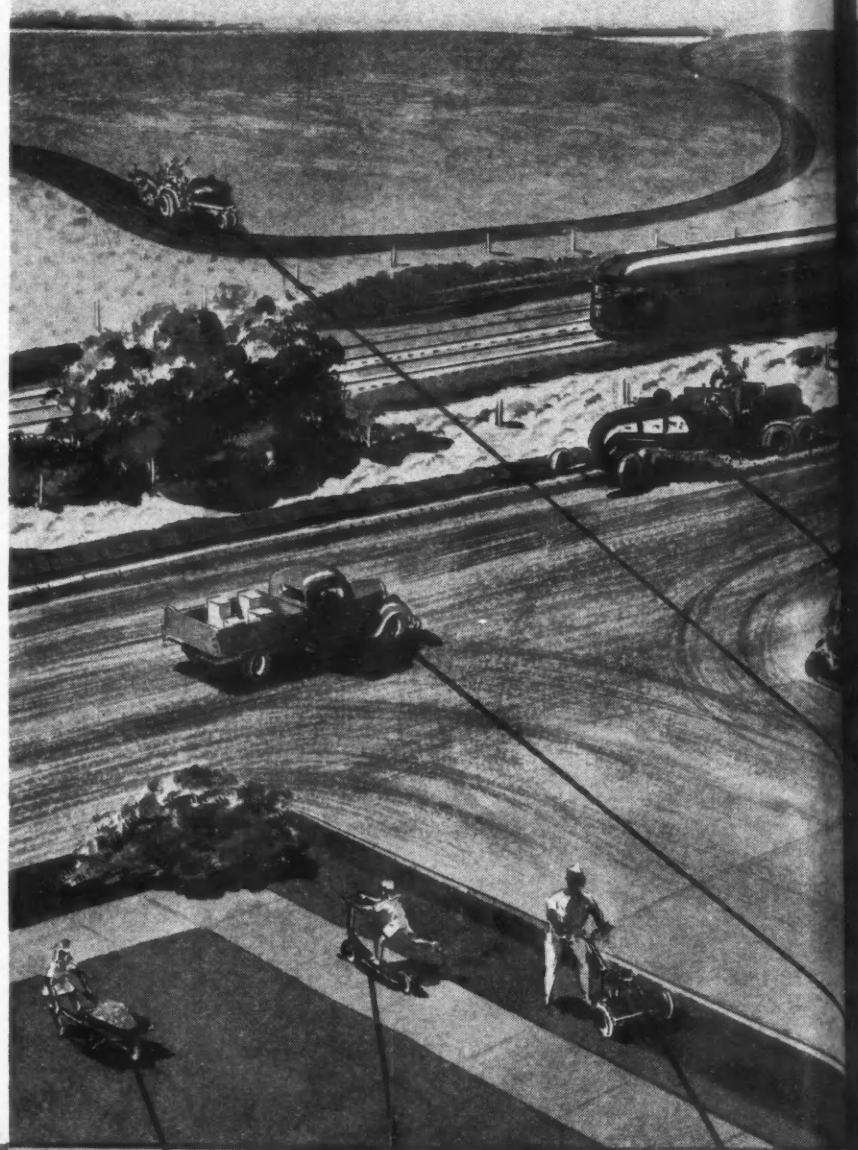
We of United Specialties Company are proud of our part during the past quarter of a century in the development and refinement of the internal combustion engine, the many applications of which have so mightily contributed to our modern American way of living.

United Oil Bath Air Cleaner protection over that period of time has consistently improved the performance and increased the life of engines on cars, trucks, busses, agricultural and industrial tractors and all types of Diesel and gasoline power units.

In safety of vehicle operation and driver convenience our Mitchell Division pioneers units such as semi-automatic directional signal switches and ignition switches. Other contributions to modern living, coming from our rolled shape department, consist of such products as automotive window frames, locomotive and railroad coach side panels, rolled material for lighting reflectors and pre-fabricated housing sections.

Such close contact with so many facets of industry induces a spirit of perpetual alertness. We are constantly looking ahead towards improvement of product, its design and production. This is both a habit and a "must".

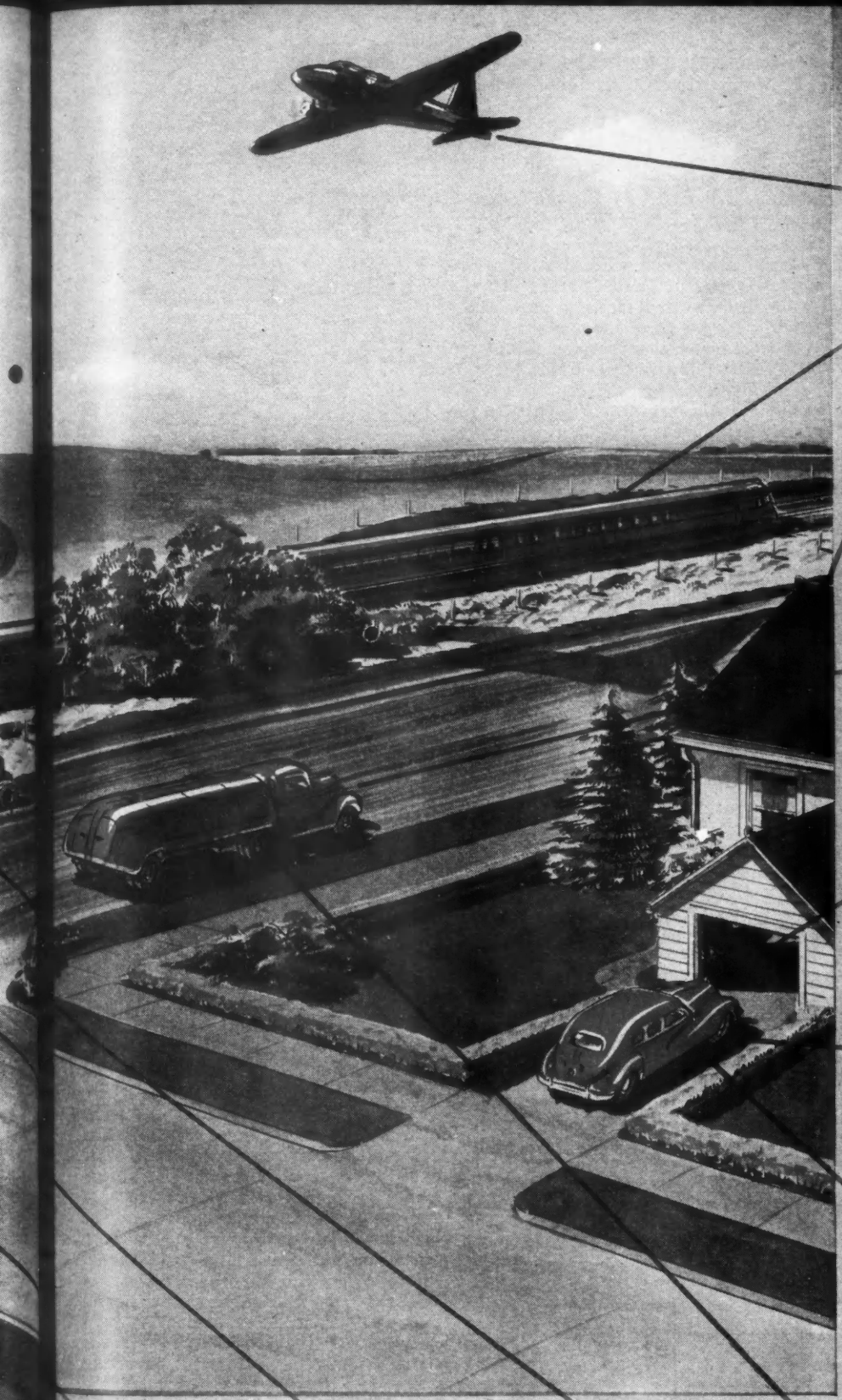


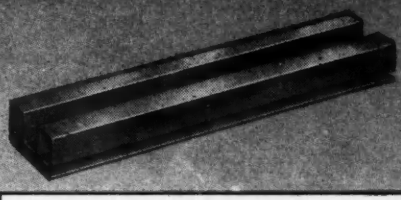
The toy wheelbarrow and scooter shown here are products of our new toy and wheel goods division. Benefitting from our extensive stamping experience, they are unusually sturdy, attractive, well-built and reasonably priced.

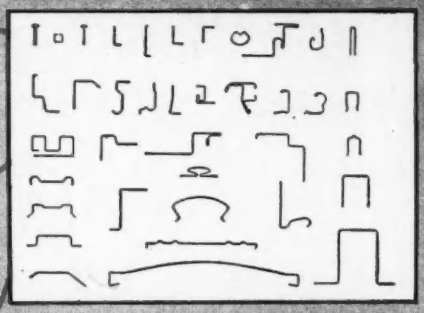
This United oil bath air cleaner affords real dust protection for small engines used on garden tractors, power lawn mowers, motor scooters and many other applications of such power units.

UNITED
SPECIALTIES COMPANY

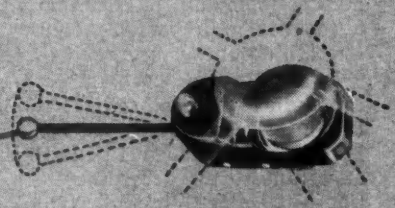
United Air Cleaner Division • Chicago 28
Mitchell Division • Philadelphia 36



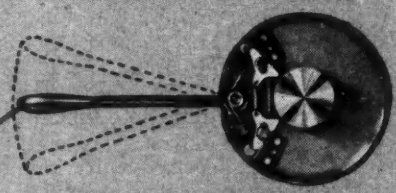




Metal rolled shapes produced in Philadelphia plant — complete range of metals, designs, gauges, stainless steel, aluminum, brass, bronze copper cold rolled, drawn and pressed for automobiles, airplanes, architectural requirements, railroad cars, radios, all industrial uses.

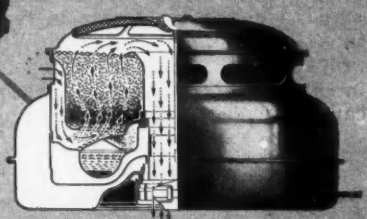


New Mitchell clamp-on semi-automatic directional signal switch designed especially for trucks.

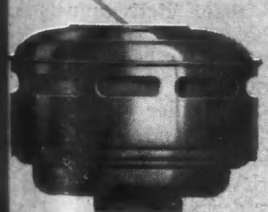


Mitchell built-in type semi-automatic directional signal switch used in passenger cars.

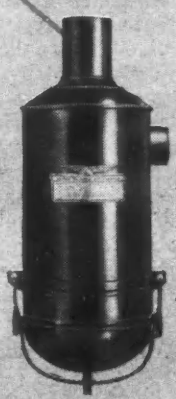
Conventional type Mitchell ignition switch used on popular makes of cars and trucks.

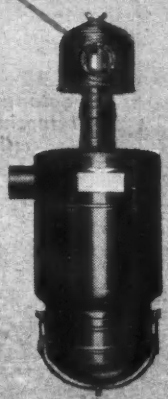


New style combination oil bath cleaner and silencer designed for use on down draft carburetors where head room is not available for conventional type combination cleaner and silencer.



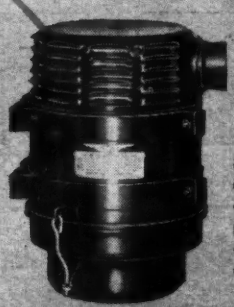
Popular style of oil bath air cleaner used on trucks where cleaner is mounted directly on air horn of down draft carburetor.





Tractors, combines and other agricultural gasoline engines are protected by this standard type United oil bath air cleaner.

This United oil bath air cleaner is designed especially to protect Diesel engines in truck, tractor, grader and industrial power units, where wide range of engine speed occurs.



Heavy duty truck oil bath cleaner. Distinctive features are great dirt-trapping capacity with extremely high cleaning efficiency, large oil reservoir and ease of servicing.

the air is less drying to the skin than if higher air temperatures are required. Fog or frost is prohibited on all windows and an adequate flow of fresh air is provided to suppress odors without annoying drafts.

New Instrument for Fuel Rating

The Knockometer

By P. J. Costa and J. W. Wheeler
Engineering Div.
Sperry Gyroscope Co., Inc.

THE Sperry Knockometer Model KM-1 was specifically designed to detect a standard knock level in order to rate aviation fuels by the CRC-F4 Supercharged Procedure. The instrument indicates knock by an instantaneous flash on a neon indicator while a quantitative measurement is registered on a meter, employing the combination of an automatic gain control circuit and a knock differentiating circuit.

In the F-4 Procedure, the rating of an unknown fuel is determined by plotting fuel-air ratio against knock limited IMEP. The unknown fuel is then given an octane rating according to the relationship between it and a similar plot for one or more reference fuels. To avoid errors in octane ratings, the standard knock limit must be detected accurately, IMEP must be correctly measured, and engine operating conditions must be maintained at the standard values within close limits.

In the KM-1 Knockometer, the knock differentiating circuit discriminates between normal combustion and knock. By selecting a neon tube with a suitable ionization potential, and by using this ionization potential as a reference level, any voltage in excess of a predetermined value is cut off. A normal combustion pattern is shown in Fig. 18. When knock occurs, the neon bulb will glow and cut off the upper and lower sections of the relatively large knock signal. The clipped off portions are passed to the meter circuit to be measured and the remainder is fed back into the gain control circuit. With the proper choice of circuit components the integrated value of the unclipped signal can be made to simulate that of the normal combustion which existed before knock occurred. Also, in order that the amplified electrical signal is maintained as an enlarged facsimile of the mechanical vibration wave, the response of the automatic gain control circuit is made slow. Therefore, with the proper selection of time constants, it is possible for the instantaneous high amplitude waves to be faithfully amplified. By means of the meter integrating circuit a value proportional to both intensity and frequency of occurrence of knock over a period of time is indicated since engine damage is a function of both.

In rating fuels by the EF-2 Motor Procedure the unknown fuel is used in the engine, and the compression ratio is increased until the Knockometer reads approximately 55 at maximum knock fuel-air ratio. The mechanical arrangement for adjusting compression ratio is then locked and the unknown fuel bracketed by using two reference fuels, one above and one below the approximate octane rating of the unknown fuel. Octane ratings are then calculated by the proportionate Knockometer readings. For example, if two reference fuels of 74 and 76 octane give knock readings of 60 and 40 respectively, and the unknown fuel reads 50, the rating of the unknown fuel would be midway between the two reference fuels, or 75 octane.

In the development of the KM-3 electronic Knockometer for the EF-2 Motor Procedure, the automatic gain control circuit was removed and a less sensitive but more stable meter circuit necessary for the motor method was installed. It was necessary to have voltage regulation for this circuit. The ideal location for the pickup was found to be on the cylinder head because of the larger combustion vibrations and a minimum of other mechanical engine noise. These larger signals reduce installation problems and are conducive to a more simple and reliable knock instrument. The pickup position has very little or no effect on fuel ratings or the electronic guide curve.

Generally, the KM-3 Knockometer is approximately twice as sensitive and a little less steady than the bouncing pin. Meter stability and sensitivity decrease with lighter knock (a positive deviation from the guide curve). Sensitivity and stability improve as knock intensities increase, but at very heavy knock, stability continues to improve, sensitivity begins to fall off, and it is very difficult to reproduce data. Fuel blends and octane ratings also affected sensitivity.

In comparing octane ratings between the KM-3 and the bouncing pin, the KM-3 appears to increase the ratings by approximately 2.5 octane. The increase may be larger above 90 octane. However, complete data in many laboratories will be necessary to establish true differences in octane ratings. The reason for the difference in fuel ratings is because the bouncing pin does not always measure audible knock accurately. In fact, for some time it has been known that the bouncing pin will rate standard and reference fuels as being of similar knock value when actually, if rated by aural knock, the same fuels might be several octane numbers apart.

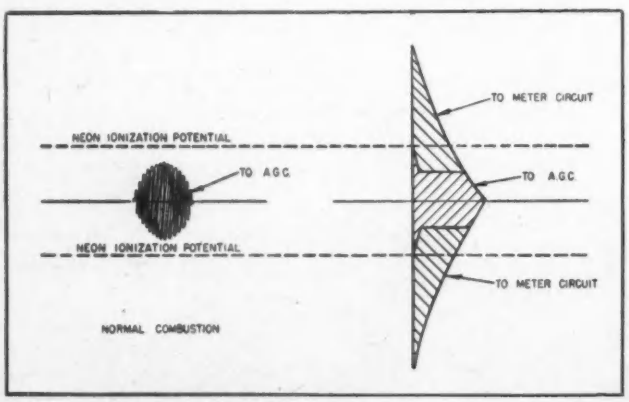


Fig. 18—Theory of detonation discriminating circuit

Low-Cost High Speed Wind Tunnel

Wind tunnels for testing airplane models at supersonic speeds may be within the financial reach of many American aircraft factories if a new German design principle is adopted, according to a report written by Otto Franzl, an engineer of the Junkers aircraft plant in Germany, for the U. S. Army Air Forces. Tests conducted in Germany indicated that the new wind tunnel design involved only one-tenth the investment cost of current designs, the report states.

The key to the wind tunnel's operation is that the readings are made in a few seconds, so that while the wind speed is tremendous, it is of short duration. In operation, a large store of energy is suddenly released. The energy is stored in water heated by steam under pressure in an accumulator. When this superheated water is released from the accumulator, its almost instantaneous expansion causes a vacuum which draws air through the tunnel. For experiments involving speeds less than the speed of sound, the tunnel has a working space of about 6.5 by 7.5 ft. The supersonic speed tunnel is smaller, with a maximum space of 1.64 by 3.28 ft. Both tunnels are connected to the same accumulator. The vacuum principle is used in the wind tunnels of the U. S. Naval Ordnance Laboratory now under construction at white Oak, Maryland. At this laboratory, however, a vacuum sphere is used to store the required energy, and the rush of air occurs when valves are opened to the atmosphere.

what percentage CARBON?

Carbon content in metal, permeability in sand mixture, hardness of rammed molds . . . these and hundreds of other details are part of the complex casting procedure. They demand specialization, experience and the most complete foundry facilities. All parts cast in any of the five Campbell, Wyant and Cannon foundries prove in themselves the value of thorough metallurgical control and specialized foundry practice. Modern C. W. C. equipment quickly and efficiently provides the means for quantity production which results in desired economy.

C.W.C. engineers and metallurgists are ready to apply modern casting technique to the development of new products. Consult them in the early stages of your new product ideas.

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Centrifugal Fusing Co.

CARBON DETERMINATOR

In the C. W. C. chemical laboratories, many types of equipment contribute to the quality and uniformity of the casting. The equipment used for total carbon determinations (shown in the above painting) is one of the most important. It accurately and rapidly determines carbon content of a particular heat in approximately six minutes. And time is of the essence because the heat is held pending the results. Proper control is one of the greatest factors in the modern casting process.

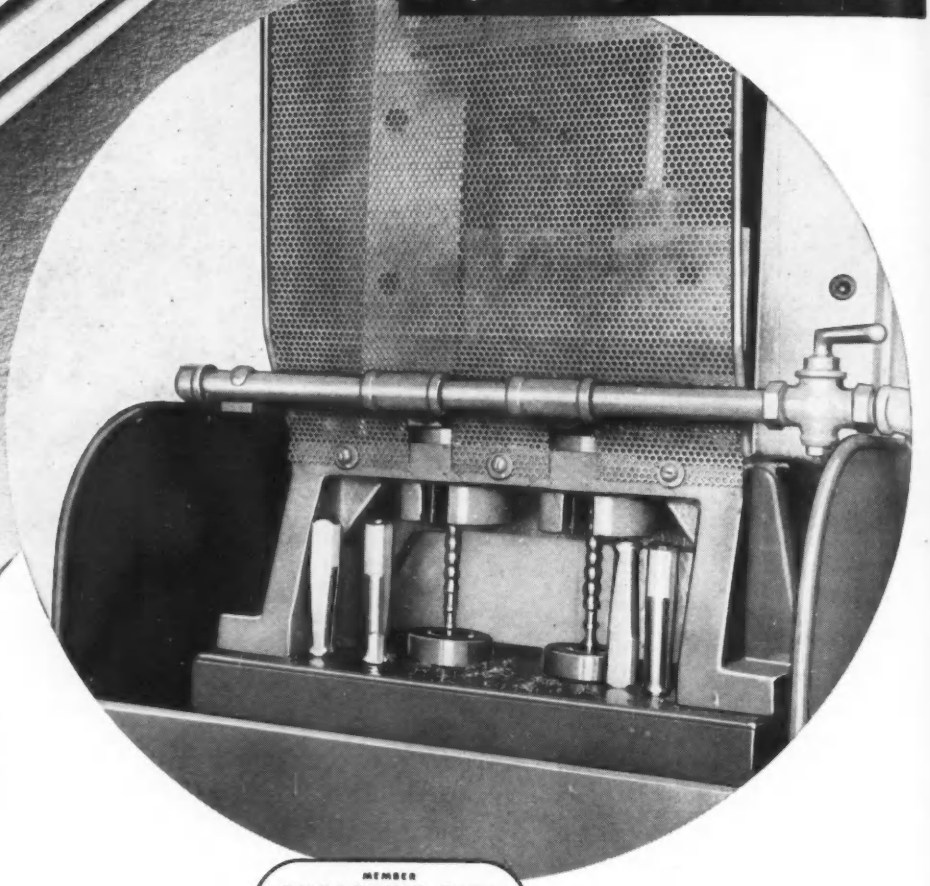
CAMPBELL, WYANT AND CANNON FOUNDRY COMPANY

MUSKEGON, MICHIGAN

Engineering Library

Kirsten

BROACHED BY ★ American



Accuracy and smooth finish are required for the holes in Kirsten pipe radiators and cigarette holder bodies. Close tolerances are needed to fit the arbor for subsequent milling operations on the stem exteriors. Smooth finish is likewise important on inner bores. All these specifications—*plus* an extremely high rate of production—are met in broaching by *American.*

Kirsten master mechanics use the popular *American* T-4 type Broaching Machine, one more example of the many ways in which broaching by *American* can be applied to a wide range of metal working problems.

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DIVISION OF SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

Illustration shows *American* Hydraulic T-4-24 Broaching Machine tooled for broaching cigarette holders and pipe radiator stems.

Two parts are loaded into fixture and the broaches lowered, by means of a special hydraulic retriever unit, thru the parts till the shank ends connect to the pull heads. The main hydraulic machine slide then pulls broaches thru parts—operator removes parts, slide is then reversed to bring broaches up to retriever unit which hydraulically raises to extreme up position ending one complete cycle.

As operator's only function is to insert and remove parts and operate machine levers, production is high—250 pieces per hour. Tolerance is held to .001.

Paris Postwar Air Show

(*Continued from page* 21)

the tail piece, 1985 lb. Weight is 2645 lb.

Hispano-Suiza has adopted gasoline injection for both its 12 cylinder and 24 cylinder liquid cooled engines. This latter has cylinders of 150 by 170 mm bore and stroke, with a compression ratio of 7, and a centrifugal blower at the rear of each bank of 12 cylinders. The Lavalette injection pumps are mounted on the outside of each bank of 12 cylinders, the fuel being injected into the cylinders through Lavalette Type KFD injectors. With the injector system there is an overlag on the timing, the inlet and the exhaust valves being open simultaneously near upper dead centre. The injector pump output is controlled automatically in relation to the weight of air admitted to the cylinders. Four sodium cooled valves per cylinder are used. Concentric air screws are driven through reducing gears.

Produced by the State Arsenal at Chatillon, near Paris, the 24-H is an effort to produce an engine of greater power than the Pratt & Whitney 4360. One engine develops 3500, but by mounting two in tandem 7000 hp becomes available. Many of the parts of the 24-H are those of the German Jumo 213, but since the Germans were limited to 87 octane gasoline, much higher power can be obtained with 100 octane fuel now available. The basis of this engine is two independent units, each one forming the vertical branch of an H, each one having its own compressor, ignition, injection pump and starter. The reducing gears drive one or two coaxial propellers, so designed that the stoppage of one branch of the H does not involve the stoppage of the opposite branch. The engine consists of two light alloy castings, each one with 12 cylinders—6 opposed to 6—bolted together, the crankshaft being mounted on the outside of each block, and thus being available for inspection, together with the connecting rod bearings, by the removal of a lateral cover plate. The cylinders have nitralloy liners, and the valves are in the head. All the accessories are at the rear and the reducing gear in an elongated nose at the front. Take off power is 4000 hp at 3250 rpm and nominal 3000 hp at 3000 rpm. Dry weight is 4080 lb. Provision is made for running these motors in tandem, and accessory drives can be taken off the transmission shaft.

A flat six of 324 cu in. piston displacement, capable of being fitted inside a wing, was presented by Sir Roy Fedden, former Bristol engineer. With a width of 31.7 in. and a length of 34.75 in., the height is only 14.75 in. A feature of this engine is that the fins are in the axis of the cylinders, the air being ducted around them and directly on to the head. The engine is the single sleeve valve type, with three intake and two exhaust ports. Direct injection of gasoline is employed. Without reduction gear the power at takeoff is 163 hp at 2750 rpm, being increased to 185 hp at 3400 rpm with a reducing gear. Dry wt is 310 lb without reducing gear.

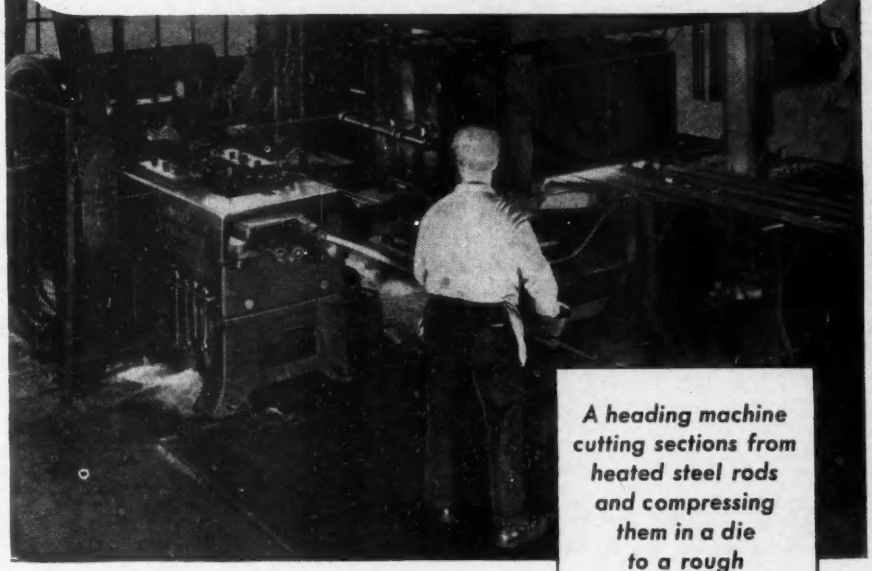
Sir Roy Fedden also showed plans of a propeller turbine giving 1305 shp and a jet equivalent of 120 hp. Weight is 750 lb, diam 27 in., length 59.5 in. Apparently it is still in the experimental stage.

The Paris Show of 1946 will stand out for its display of jet-reaction and turbine engines. Rolls Royce exhibited their two jet engines, the Derwent and the Nene (see Sept. 1, 1946 issue of AUTOMOTIVE AND AVIATION INDUSTRIES), both of which are in production. Although not shown, it is understood that Rolls Royce is working on a propeller turbine, with axial flow compressor, named the Dart. Four of these will be fitted in the Vickers VC 2.

De Havilland displayed two main types of jet-reaction engines, the Goblin and the Ghost (see Sept. 1, 1946 issue of AUTOMOTIVE AND AVIATION INDUSTRIES), the former with 16 combus-

This is How

STROM BALLS are Born



A heading machine cutting sections from heated steel rods and compressing them in a die to a rough spherical shape

The steel is carefully chosen and inspected, even before it gets to the heading machine. After being "born" here, balls are carefully "brought up," through a long series of grinding and lapping operations, to the unbelievably high standards of finish, sphericity and precision which have made Strom Metal Balls the standard of Industry. Strom Steel Ball Co., 1850 South 54th Avenue, Cicero 50, Illinois.

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tion chambers and a thrust of 3000 lb at sea level, and the latter with 10 chambers and a thrust of 5000 lb. Armstrong Siddeley had the Python gas turbine engine in a prominent position on the stand. This machine first ran in March 1945 and passed its acceptance tests during the following month, since when some hundreds of hours of development running have been carried out. Performance figures are shown in the table on this page.

General layout of the engine, as shown by the drawing accompanying Python photo, is as follows: air is taken in at A through eleven radially disposed ducts leading into an annulus B at the entry to the compressor. The air, moving forward through the compressor, is displaced radially outwards at the high pressure end by means of rings of guide vanes C; it is then divided into eleven flows and is deflected backwards through eleven elbows D into the combustion chambers E through which it passes into the manifold F. Here the 11 air streams pass between the intake passages A and are reformed into an annulus at the entry of the turbine. The gases then flow through the two-stage turbine G into the exhaust cone and through the propelling nozzle K to the atmosphere.

Full information regarding the Python has not been released. Redesigned from the earlier ASX engine, extra power is provided by arranging for the turbine to expand the gases down to atmospheric pressure, leaving only the minimum possible energy in the exhaust system.

Python Performance Data

	Engine Speed, rpm	Aircraft Speed, mph	Propeller Shaft, hp	Net Jet Thrust, lb	Fuel, Imp. gal per hr
Maximum take-off	8000	0	3670	1150	388
		200	3950	760	372
		300	4290	590	388
		400	4860	420	401
		500	5520	280	425
Maximum climb	7800	0	3150	1060	323
		200	3450	660	334
		300	3800	490	348
		400	4200	320	361
		500	4950	170	384
Maximum continuous cruising	7600	0	2720	950	290
		200	2960	570	300
		300	3260	390	308
		400	3680	220	325
		500	4250	60	341

Perhaps more interesting than Python, however, is the Mamba gas turbine propeller engine. Giving 1010 shp and 320 lb residual thrust at sea level take-off at 14,500 rpm, the diameter of this engine over the cowling is only 27 in. and dry weight 750 lb, which means that the frontal area is only about 30 per cent that of an equivalent piston engine and the weight only 75 per cent of a reciprocating engine. This engine has straight through flow, the air intake being arranged immediately behind the propeller spinner. After compression it flows directly into six combustion chambers, and thence directly through the axial flow turbine and through the exhaust system to atmosphere. While structural details are withheld, it is understood that the Armstrong Siddeley factory is now tooling up for production.

Bristol has the Theseus gas turbine engine, claimed to be the only one to use a heat energy recuperator, and which eventually will be employed on the big 167 Atlantic airliner now under construction. The Theseus gives 1950 shp with a residual thrust of 500 lb at sea level at 8200 rpm. Its principal dimensions are 48 in. overall diam, with a length of 106 in. Dry weight is 2310 lb. It is understood that Handley Page will fit the Theseus in the Hermes III 63 passenger having a 3340 miles range of action and a maximum level speed of 345 mph.

Latest development of Metropolitan-Vickers is the F5 jet propulsion engine with open fan augmentor. This consists of the F 2/4 jet propulsion engine combined with a new design of open fan augmentor. Gases pass from the generator unit through a straight duct to the augmentor turbine and thence exhaust through a propelling nozzle. The augmentor unit is intended to be mounted behind the trailing edge of a wing, or at the stern end of a fuselage

(*Turn to page 70, please*)

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Engineering Library

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Throughout other parts of Canada, hundreds of Layne Well Water Systems are also serving cities, factories, military and ammunition plants, and a very wide variety of general municipal and industrial uses.

Neither geographic location nor climatic conditions affect the high efficiency, long life, low operation cost or unmatched dependability of the world famous Layne Well Water Systems. For literature, address Layne & Bowler, Inc., General Offices, Memphis 8, Tenn.

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Layne Vertical Turbine pumps are available in sizes to produce from 40 to 16,000 gallons of water per minute. High efficiency saves hundreds of dollars on power cost per year.

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LAYNE

WELL WATER SYSTEMS
VERTICAL TURBINE PUMPS

or boom. It can thus be regarded as a contrarotating turbine and a direct coupled fixed-pitch propeller with a gas propelling nozzle. Both rotors are free running, that is to say they are controlled in speed simply by the balance between turbine input and fan output. Having a fixed pitch, the fan has been designed to operate at maximum efficiency at a cruising speed of 400 mph at 20,000 ft. The enchanced performance is obtained with only a 30 per cent increase in weight over the simple F 2/4 jet propulsion engine. It gives a better specific consumption over a wide range of flight speeds with an improved specific weight, but these advantages do not apply at high speeds over 500 mph. Having no gears, it is lighter and simpler than the gas turbine propeller scheme.

The Metropolitan-Vickers F 2/4, which is a straight jet propulsion engine, has a rated static thrust of 3500 lb, but is said to have considerably exceeded this in bench tests. Its diam is 37.25 in., length 161 in., weight 1785 lb and maximum speed of rotation 7700 rpm. In parallel with the development of the simple jet propulsion engine, Metropolitan Vickers has designed a ducted fan thrust-augmented engine, known as the F3 (see Sept 1, 1946 issue of AUTOMOTIVE AND AVIATION INDUSTRIES), its outstanding features being high thrust and low specific fuel consumption at the take-off rating.

Panels of Plastic With Photographic Reproduction

(*Continued from page* 32)

quarter panel which covers the fender well, the cured laminate is placed in a forming fixture while hot and shaped to the desired contour. These fixtures also serve as templates for drilling holes and marking the stock for band saw trimming. Because inexpensive fixtures can be used, this method is both economical and fast for handling large pieces, the manufacturer stated.

In producing items with sharp contours, such as Packard garnish moldings, another method is used. The stock is laminated and molded in one operation using steel dies. The loading and unloading of dies with raw plastic material is done outside the press bed, making possible the maximum utilization of press time by running duplicate dies from the opposite side of the press.

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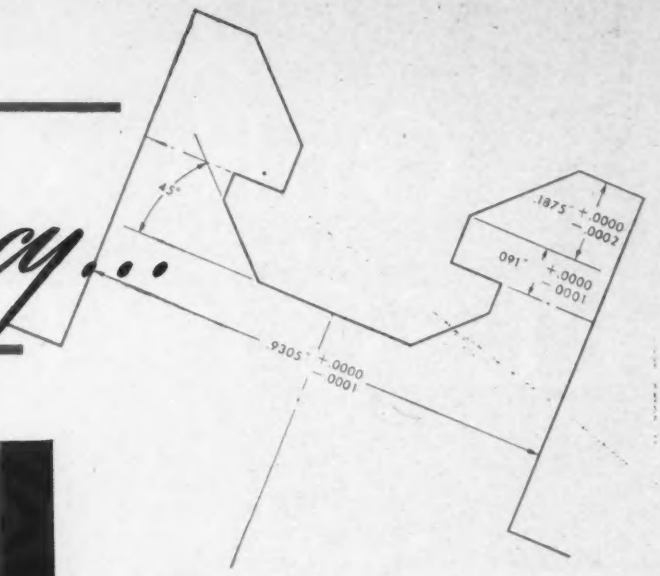

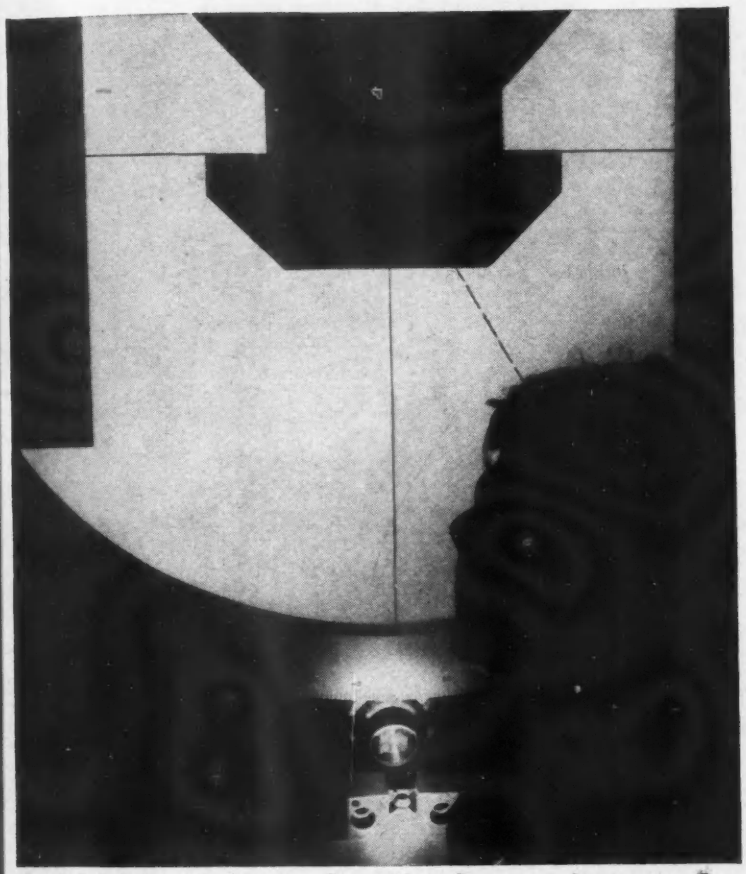

PHOTOGRAPH Courtesy The Elliott Company, Jeannette, Pa.

THE dovetail shanks of steam turbine blades and many other turbine components are inspected easily and quickly on Jones & Lamson Optical Comparators. By any other means inspection would be a slow and costly process.

Jones & Lamson Optical Comparators provide a rapid and extremely accurate method for inspecting even the most complex forms.

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Give you *all* these Time-and-Money-Saving Advantag

Engineered to meet the Specific Needs of Trailer Braking

SIMPLICITY — No other brakes equal Warner Electric Brakes for simplicity of design and construction. Full clearance under tractor and trailer. Nothing to get knocked off, leak, chatter or freeze. No exposed braking equipment . . . no rods to rattle . . . no tubes to split . . . no troublesome boosters and connections. Easy to install . . . no tapping of manifolds . . . no expensive motor work.

INSTANTANEOUS, POSITIVE ACTION—Positive-acting braking power is developed within the brake itself. Because the braking mechanism is *electrically controlled,* there is no time lag. Regardless of distances from cab to rear trailer wheels, any amount of stopping power is *instantly available.*

CONTROLLED BRAKING POWER — Driver can pre-set the "Vari-Load" dial on dash so it adjusts the electric brakes on the trailer to give correct braking to meet road and load conditions.

SYNCHRONIZED OPERATION WITH EITHER AIR OR HYDRAULIC SYSTEMS—Warner Controller synchronizes hydraulic or air brakes on tractor with Electric Brakes on trailer. Regular tractor foot pedal then operates both systems *together.*

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UNMATCHED ECONOMY—Warner Electric Brake are inexpensive to install due to their simplicity. Us only as much current as tail light. The most importan economy factor is that they require minimum of se vicing thus preventing costly delays and tie-ups o trailer equipment.

PROVED DEPENDABILITY — Warner Electri Brakes have been performance-proved by leading trac tor-trailer fleet operators during many years of efficient trouble-free service — also on thousands of militar vehicles. It is noteworthy that 80% of all power-brak equipped trailing vehicles purchased by the governmen during World War II — had Warner equipment.

GREATER SAFETY—When both the tractor an trailer are equipped with Warner Electric Brakes thei *instant* "stopping power" under *absolute control* assure greater safety. All brakes "come in" at the same time but with various *amounts* of power. Therefore, rea trailer wheels get the effect of coming in first — an the tendency to skid or jack-knife is prevented, thu giving protection to driver and load — and avoidin costly repairs and tie-ups of equipment.

For best performance and customer satisfaction, standard ize on Warner Electric Brakes for your trailers. Write for illustrated literature explaining all their advantages.

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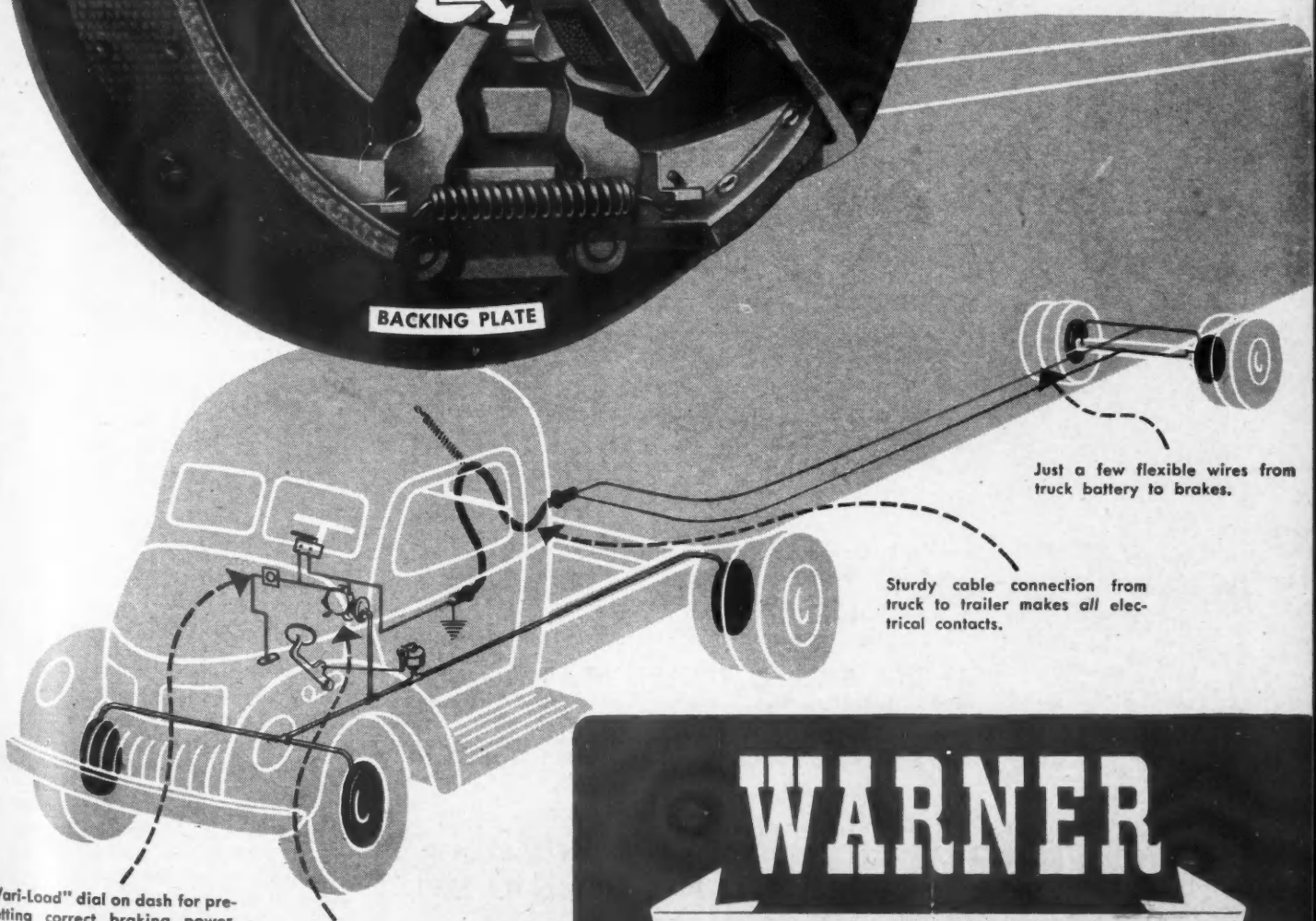
Specialists in the manufacture of Electric Trailer Brakes since 19

The Warner Electric Brake is a simple mechanical brake, operated by an electro-magnet and armature disc. Each wheel is a complete brake unit. The braking power is generated within the brake itself. A wire to the battery and a controller complete the system — famous for its simplicity.



Just a few flexible wires from truck battery to brakes.

Sturdy cable connection from truck to trailer makes *all* electrical contacts.

"Vari-Load" dial on dash for presetting correct braking power.

Controller operates trailer's electric brakes *in unison* with truck's hydraulic or air brakes.

WARNER
ELECTRIC BRAKES

Unique Tooling at Saginaw Plant

(*Continued from page* 29)

in a No. 2 Cincinnati Centerless grinder, holding to 1.138/1.139 in. The cone ends, previously shaved in the Sundstrand, are ground to form at both ends in a Van Norman radius grinder. This is followed by precision thread grinding of the thread groove in a battery of Jones & Lamson automatic external precision thread grinders. The form of the thread is held to 0.0002 in. in this operation, all thread grinding operations also being closely held as to lead and root diameter. The work is then washed and finish-inspected.

As mentioned earlier, the malleable iron housings are machined in a battery of Bullard Mult-Au-Matics of single-index and double-index type, depending upon the operation at hand. Perhaps the most important feature of the Bullard machining method is the fact that long bores, finished by reaming, for the installation of bearing inserts are held to a tolerance of 0.001 in. which is said to be exceptional considering the relatively large length-to-diameter ratio. In fact, previous practice was to precision bore to get the necessary accuracy.

The steering gear shaft has some unusual operations, particularly the turning of the taper end in the first operation on a Greenlee bar automatic. This machine is fitted with a unique magazine feed mechanism, consisting of an inclined rack onto which the operator places the bars. The magazine function is then automatic. As a bar is fed into the machine, a roller mechanism rolls another bar into position for feeding. Then a pusher mechanism pushes the bar into the collet. Following machining of the taper end, the shafts go to a Reed thread-rolling machine, for rolling the thread at the ends. Later the worm and shaft are joined into a single piece by butt welding in a large Federal resistance welding machine and the flash removed by a turning operation.

The final phase, naturally, is the assembly of steering gears. Component parts flow on the overhead monorail conveyor which threads the plant, leading eventually to the assembly department. Of the sub-assembly stages an important one is inserting the horn wire in the shaft and making up the electrical connection at the top end. The shaft then is straightened and goes to the sub-assembly station where the nut is assembled on the worm, the balls being fed into the grooves from an automatic assembly machine. The next step is the installation of the two circulating ball tubes previously loaded with balls, and fastening in place by means of clips.

Final assembly is done on the conveyor assembly line. In the initial stage, while the shaft is being fitted into the housing, the outboard end of the shaft is supported on a short auxiliary conveyor installed parallel to the assembly line. The remaining parts such as the sector, bearings, covers, etc., are added at the various stations as the assembly moves down the line. Adjustment of the worm and sector is done in two stages—first the worm is adjusted for end-play, then the sector. For each of these operations they use two operators, one to do the adjustment, the other for checking the torque of the shaft by means of a special wheel which is attached to the shaft in the same position as is the steering wheel. This hand wheel has a torque measuring mechanism similar to a torque wrench. Portable pneumatic tools are employed on the assembly line for making up the fastenings.

It may be mentioned at this point that the heat treating department is outfitted with the latest types of equipment, principally Surface Combustion furnaces of various types, including a large S-C pusher type annealing furnace and continuous carburizing furnaces. All of the equipment in the heat treating department is controlled as to cycle and temperature level by means of familiar instruments.

Lucky Star for any vehicle .. Aetna

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Aro Speed Couplers are designed for easy "push on" attaching—for coupling an air hose to any air tool or device. They permit the use of many tools with one air line. The Aro Speed-Coupler swivels freely . . . eliminates twisting and kinking of hose . . . prolongs hose life. To detach, merely "pull off". It's leak-proof with a shut-off valve in Coupler which closes automatically when detached. No other valves necessary. Coupler cannot be accidentally detached.

Aro Speed-Couplers available in a complete line for use on air lines, water lines and steam lines. Precision-built . . . dependable. Ask your Aro Jobber or write . . . The Aro Equipment Corporation, Bryan, Ohio.

JUST— PUSH ON to connect it! PULL OFF to disconnect!

Specify ARO

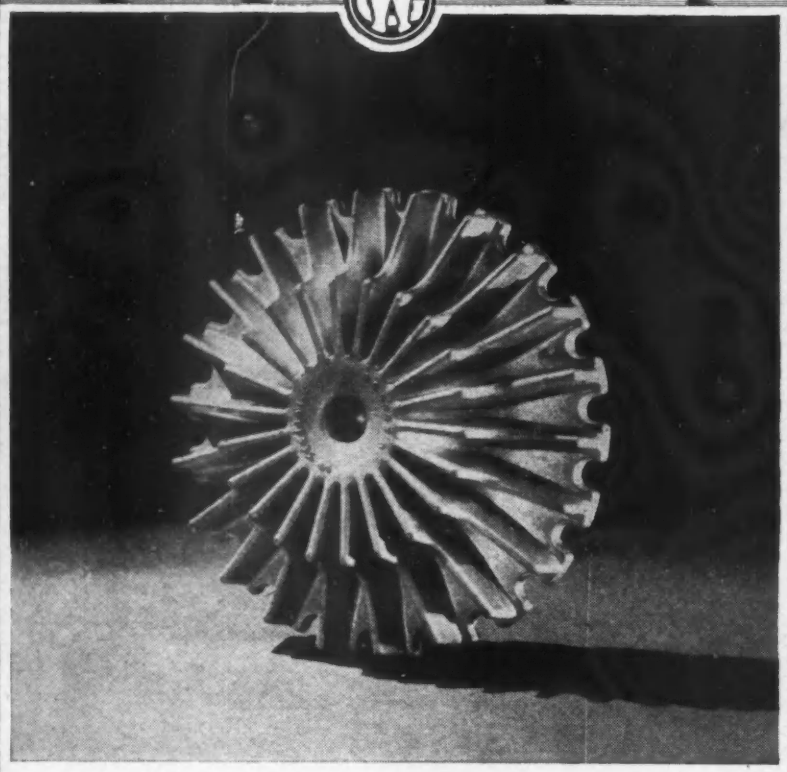
AIR TOOLS AND COUPLERS

Air Briefs (Continued from page 44)

the year assures a growing use of this type material in the coming years, particularly for high-speed aircraft.

Lightplane Noise

A significant technical contribution to light aircraft was made during the year by Theodore Theodorsen and Arthur Regier, both physicists of the National Advisory Committee for Aeronautics. Their theoretical work on the problem of noise reduction produced the fundamental theory for the construction of a virtually noiseless propeller-driven airplane. Noise has been held out as the single greatest obstacle to the national airport building program. The NACA researchers revealed a fan-type, multibladed propeller which, when used in combination with an effective engine muffler, will render a lightplane virtually inaudible from a distance of 300 ft or more while absorbing the same power from the engine and providing the plane with the same performance.



In the realm of forging design and development of proper grain flow, Wyman-Gordon has originated many forging designs in steel, aluminum and magnesium. Typical of the many intricate light alloy forgings made by Wyman-Gordon is this aluminum impeller forging for aircraft engine superchargers.

Standard of the Industry for Sixty Years

WYMAN-GORDON

Forgings of Aluminum, Magnesium, Steel

WORCESTER, MASSACHUSETTS, U. S. A.

HARVEY, ILLINOIS - DETROIT, MICHIGAN

Sweptback Propeller

Answering the problem of propeller inefficiency due to compressibility losses at speeds of 500 mph or more, a sweptback-bladed propeller was flight tested during the year which showed promise of producing usable quantities of thrust to speeds as high as 700 mph. Developed by the Propeller Division of Curtiss-Wright, the three-bladed design is characterized by blades curved in an arc in the manner of a scimitar. The design is undergoing flight tests on a Republic Thunderbolt fighter in conjunction with the Army Air Forces. Such a propeller preserves the quick take-off, flexibility of operation and fuel economy of the reciprocating engine well into the transonic speed zone offering many years of useful development life for this "old type" engine.

Upper Atmosphere

Although a major share of the achievement belongs to German scientists, the year witnessed unprecedented flights of rocket-powered missiles into the upper atmosphere. Using captured V-2 rockets fired at White Sands Proving Ground, New Mexico, scientists of the Army, Navy, industrial laboratories and universities conducted numerous fully instrumented flights to altitudes as high as 102 miles. Although the technical problems remain acute, major achievements in instrumentation, telemetering, photography and recording of data on the upper atmosphere were made. One result was a photograph taken from an altitude of 65 miles, the highest a camera has ever been taken. New secrets of the outer layer have already been obtained and technical progress made during 1946 has paved the way for extensive analysis of cosmic rays, the Heaviside Layer, temperature, density, pressure and composition of the outer atmosphere in the coming year.

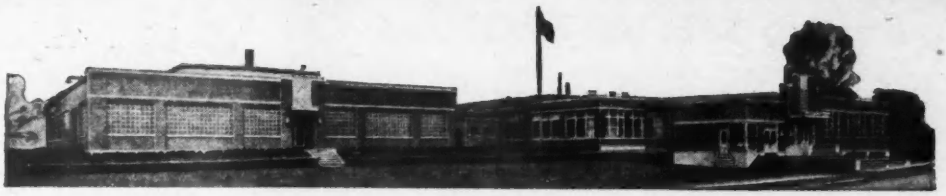
Guided Missile

During the year the Navy announced completion of development work and transfer of cognizance to operating fleet units of the first fully automatic guided missile in history. The weapon, known as the Bat, is radar-guided unerringly into its target and contains a 1000-lb bomb. It is a glider equipped with servo-mechanisms controlled by the radar equipment in the nose. It can be launched from a distance of nine miles. Although the Bat saw war service and will shortly be outmoded by countless other guided missile types, 1946 witnessed the birth of the automatic "homing" guided missile and, as such, harbingered an entirely new age in warfare.

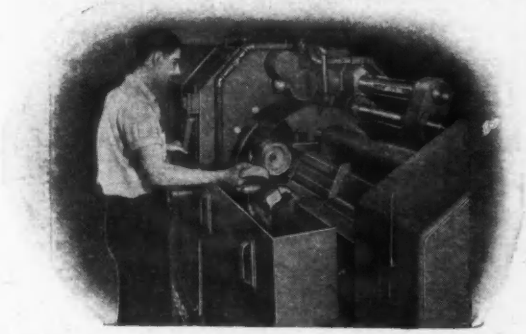
(*Turn to page* 78, *please*)

(Advertisement)

If you visit the Wico Electric plant



they will probably point out this machine



This progressive manufacturer, ever alert to increasing manufacturing efficiency, sought a better way to machine a rather large and "difficult" magneto housing. There are three different materials in the piece—aluminum die casting, steel bushing and liner, and brass spacer. The tapered hole in the bushing requires a fine finish and close tolerance. The inside diameter of the liners must also be closely maintained.

The housing was formerly turned out on four turret lathes at the rate of 28.8 per hour. New Britain engineers proposed replacing these four lathes with a single Model 695 New Britain chucking machine. Here are the results:

Regular production rate over a six-month period — 102 pieces per hour. Uniformity and over-all quality substantially improved. Cost per piece reduced from 55¢ to 12.8¢. Operator fatigue practically eliminated. Wico management reports that the new machine will pay for itself in less than two years, and completely meets every requirement on this "difficult" piece.

Since the earliest days of automatic machines, the ability of New Britains to reduce production costs and provide a foundation for increased employment has been an important factor in the growth of American manufacturing. This ability, as well as the range of work New Britain automatics can perform, is constantly being expanded by New Britain engineering and research. Why not check over *your* work with the New Britain sales engineer in your locality.

ENGINEERING DETAILS

Fourteen tools are fed in by the main tool slide, and the fact that three different metals are cut at the same time makes the production rate outstanding. To produce the fine finish and close tolerance of the taper bushing hole, two boring, one counter-boring and two taper reaming operations are performed. Two roughing cuts and one finish operation are employed to assure high uniformity and good finish in machining the segment inserts.

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If you have a SPECIAL PROBLEM

in any of these operations, where precision work is demanded and where greater production at man-hour savings is paramount—

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Strand Flexible Shaft machines provide constant speeds with greater operator convenience. Hundreds of attachments easily interchanged—125 types and sizes—models include vertical and horizontal type machines from 1/8 to 3 h.p. Distributors in all principal cities.

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Strand FLEXIBLE SHAFTS

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(*Continued from page 76*)

Sonic Airplane

The first airplane capable of flying at the speed of sound was developed during the year. The Bell XS-1 was a joint project of the National Advisory Committee for Aeronautics, Bell Aircraft Corp. and the Army Air Forces. Extensive power-off flight tests were conducted during the year and as the year came to an end its first powered flight was momentarily awaited. Rocket-powered and man-carrying, it brings man to the threshold of a new regime of speed and ushers in the age of supersonic flight.

Significance of 1946

Although it is simple to point to a year just closing as an outstanding one, certainly 1946 has been a year of vast technological progress in aeronautics. It has been, essentially, a year of transition from the aviation we have known so familiarly for so long into a new and fantastic aviation that was comic-strip material a decade ago. Certainly it has brought mankind as far along in a single year as has any other 12-month period in the 44-year history of man's conquest of the air.

Large Attendance Expected At Western Metal Congress

More than 40,000 metals scientists, engineers and executives are expected to attend the Fifth Western Metal Congress and Exposition which will be held in the two Oakland Civic Auditoriums in the San Francisco-Oakland-Golden Gate area for six days beginning March 22, 1947.

W. H. Eisenman, managing director of the Exposition and also national secretary of the American Society for Metals, stated that the estimate is based upon attendance figures of the last previous Western Metals Congress and Exposition held in Los Angeles in 1941.

Sixteen western divisions of technical societies are actively co-operating in program and other activities of the Western Metal Congress and Exposition. The list includes the American Society for Metals, sponsors of the event; the American Chemical Society; the American Foundrymen's Association; the American Industrial Radium and X-Ray Society; the American Institute of Mining and Metallurgical Engineers; the American Institute of Electrical Engineers; the American Society for Testing Materials; the American Society of Tool Engineers, Inc. the American Welding Society; the mining association of California; the Northwest Electric Light and Power Association; the Pacific Coast Electric Association; the Purchasing Agents Association of California, Inc.; Society of Automotive Engineers; Western Oil and Gas Association and the American Petroleum Institute.

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Bunting ability to deliver is traditional—whether the quantity be one or a million. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in principal cities.

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56

Engineering Library

DOUBLE DISC

Blueprint of GREATER BRAKING POWER

...with FEWER PARTS
...SMALLER SIZE
...LESS WEIGHT

Lambert Double Disc Mechanical Brake...Axle Application

1 ACTUATING DISC
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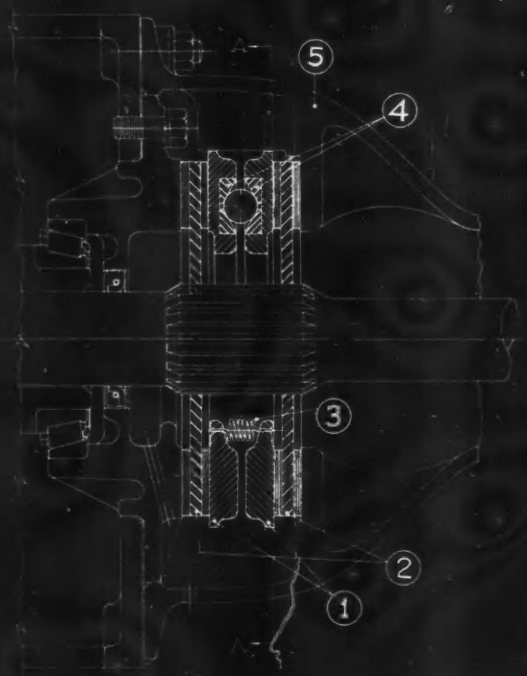
9 PULL ROD
10 LINKS



This is what surprises engineers and tractor operators when they investigate the new Lambert DOUBLE DISC Brakes. It offers MORE, with LESS! Greater advantages for tractors. More Brake Lining Area. Performs Better:—provides Increased Braking Power... Stops with Equal Efficiency going Forward or Backward...Holds Loads on Steep Grades...Requires only light Pedal Pressure...Has Long Brake Lining Life...Is Easier to Adjust and Service! *Yet this Double Disc Brake is Simpler, Smaller, Lighter!* Write for your copy of the new filing-size data sheets, explaining fully, the new DOUBLE DISC Brake.

for automotive vehicles and industrial machinery

Lambert Disc Brakes

Air • Hydraulic • Mechanical

1942

Products of a Division of the Auto Specialties Mfg. Co.
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1 A Simpler, Smaller, Lighter-Weight Brake especially designed for use on tractors.

2 Fully Tested and Approved.

3 Greater Efficiency . . . More Power.

4 Very Quick and Simple Adjustment.

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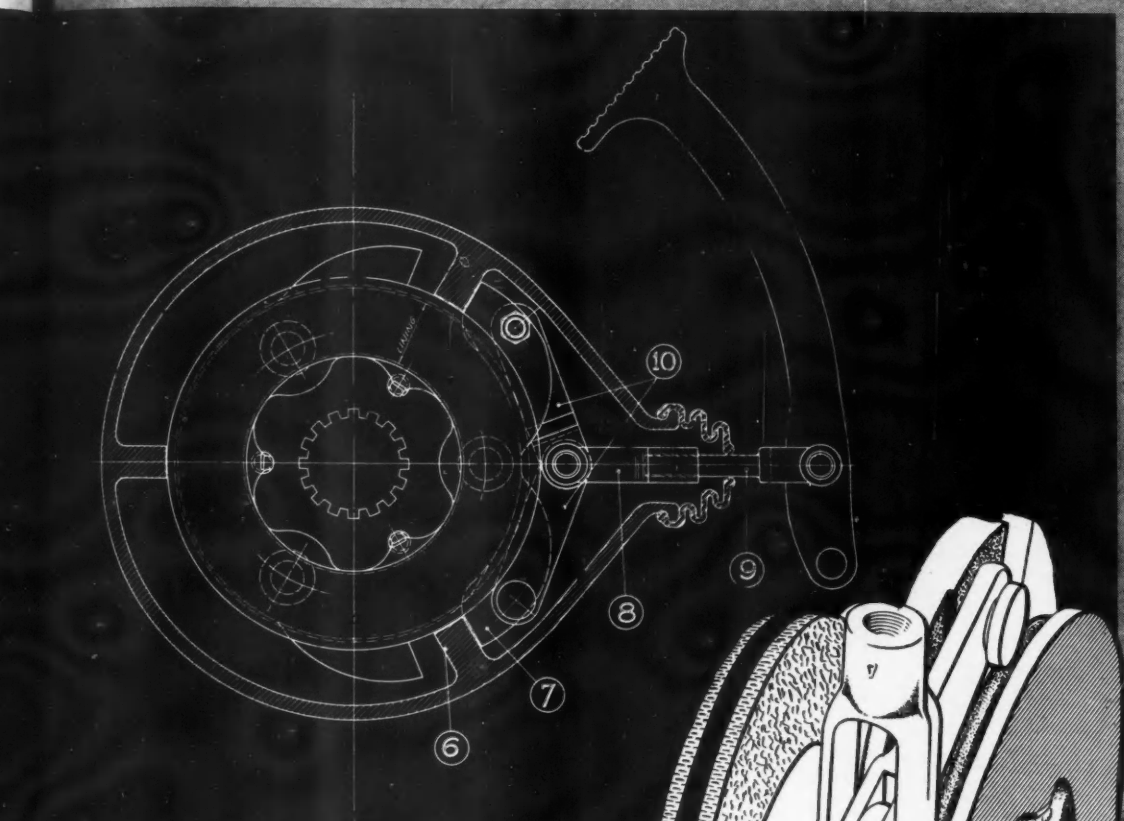
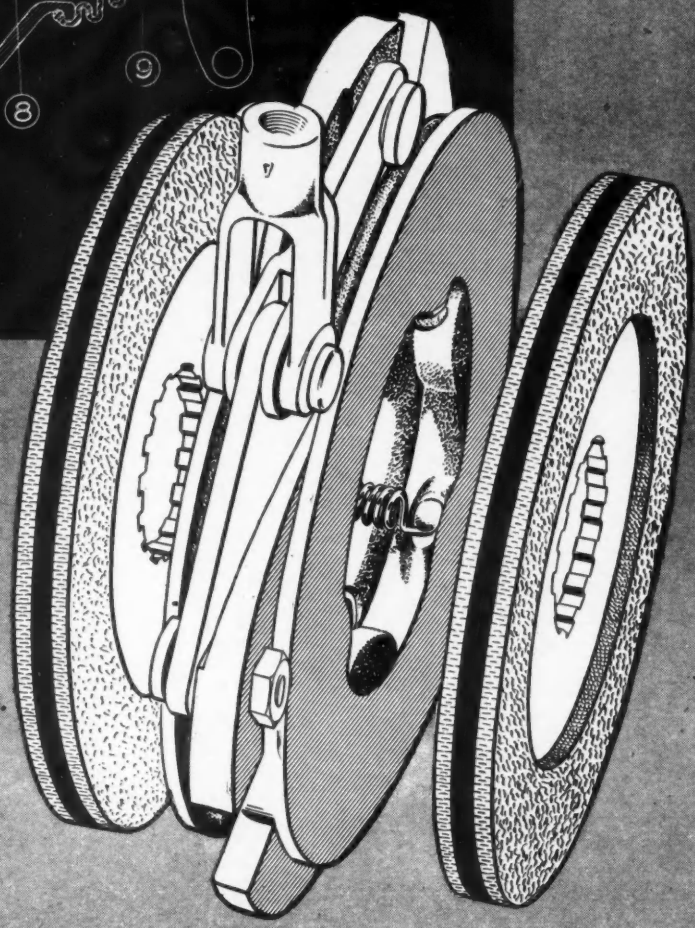




6 Light Pedal Pressure.

7 Effective Steering.

8 Four Effective Braking Surfaces.

9 Longer Brake Lining Life.

10 Easier to Assemble.

11 Fewer Parts, Which are All Interchangeable.

Aluminum Cleaning

(*Continued from page 22*)

found in nearly all cases that a precleaning operation is of the utmost importance. The function of a precleaning operation and the benefits derived from it should not be underestimated. Materials used for this purpose loosen, soften, wet out and penetrate soil that is to be removed. The cleaning that follows can thus be accomplished more thoroughly and in less time. Important savings of cleaning materials are always affected by precleaning. Precleaning also eliminates the long, costly periods of tank soaking required to remove tough deposits. It cuts the waste of cleaning materials used in the later operations because of the fact that the hard-to-remove deposits are already softened or loosened. Shorter cleaning cycles are thereby made possible.

In the case of greases, oils and carbons the precleaning is accomplished with material that has an emulsifying and solvent action. Its function is to wet out and break the bond between the soil and the surface of the metal. This provides for quick removal of the deposits by water and eventually by further treatment with another compound. It is essential that such precleaning material be easily rinsed off with water or solvent so as to prevent unnecessary contamination during subseqeunt cleaning processes.

For stamping inks, dyes and general soil a special material must be used having a pH within safe limits for aluminum, bearing in mind that aluminum is highly reactive to alkaline substances. This material must wet out rapidly with an even effect in order to get the uniform surface resistance which is demanded by electro-welding.

The removal of oxide is an important consideration for the reason that all aluminum, even though partly cleaned, has a coating of oxide which demands a special material for its removal. There are a great many materials on the market which remove oxide, but some of them deposit a black soot or smut which is worse than the oxide. It is more difficult to remove and creates more resistance than the oxide itself, beside altering the color of the metal. The oxide-removing material must be accurately controlled from a pH standpoint, must be quick in action and free-rinsing.

All the rinsing operations are important for the reason that they are intended to avert contamination and neutralization during the subseqeut treatments. Usually the ideal rinse is accomplished by rinning the water to waste. The cost of water must be ignored for the reason that to do otherwise would run the risk of faulty cleaning and result in poor economy. Frequently the compounds used in successive stages of the cleaning process are of opposite pH values. One neutralizes the other. It is obvious then that the rinse that follows the treatment with the first compound must do its work well enough to prevent carry-over into the next treatment. Often the contamination caused by such carry-over alters the metal texture and color and produces a high surface resistance.

Hot rinses are more efficient but must be controlled to avoid the precipitation of hard-water scale. They do, however, have the ability to remove contamination quicker and dissolve soluble matter more speedily. Also they promote quicker drying of parts when production time is a factor. Where excessive temperature might be a disadvantage, it is recommended that the hot rinse be followed by a cold rinse.

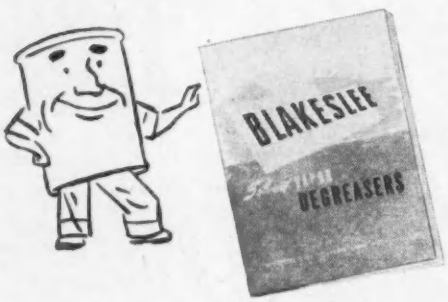
Parts which are to be welded can be handled much more conveniently if they are dry. Several methods of drying are in every day use. In the order of preference for large scale production line welding they are: infra-red lamps; hot air oven; blast of clean, hot air; hand drying with chamois. Another element in correct cleaning procedure is the use of clean canvas gloves by all operators. Otherwise soil from hands will contaminate the parts and render them unfit for the welding operation.

CLEAN and SMOOTH

METAL PARTS COME OUT FREE OF GREASE OR CHIPS WHEN CLEANED IN A

BLAKESLEE

SOLVENT *Vapor* DEGREASER



Blakeslee Solvent Vapor Degreasers employ a patented degreasing process . . . parts made of metals and alloys chemically cleaned and dried in only a few seconds . . . no need for subsequent rinsing and drying operations. Oil and grease-free surfaces are obtained, complete oil removal from cracks, pores, seams and hidden crevices of machined parts, stampings, assemblies, etc., is assured. Masses of nested parts are thoroughly cleaned and dried throughout.

In this cleaning process, the oils and greases are dissolved by BLACOSOLV, the efficient degreasing solvent which can be used on all metals or combinations of metals. BLACOSOLV is non-inflammable and non-explosive.

Write today for FREE booklet on Degreasers and applications with Blacosolv, the all-purpose degreasing solvent.

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BLACOSOLV DEGREASERS AND SOLVENT

NIAGARA METAL PARTS WASHERS

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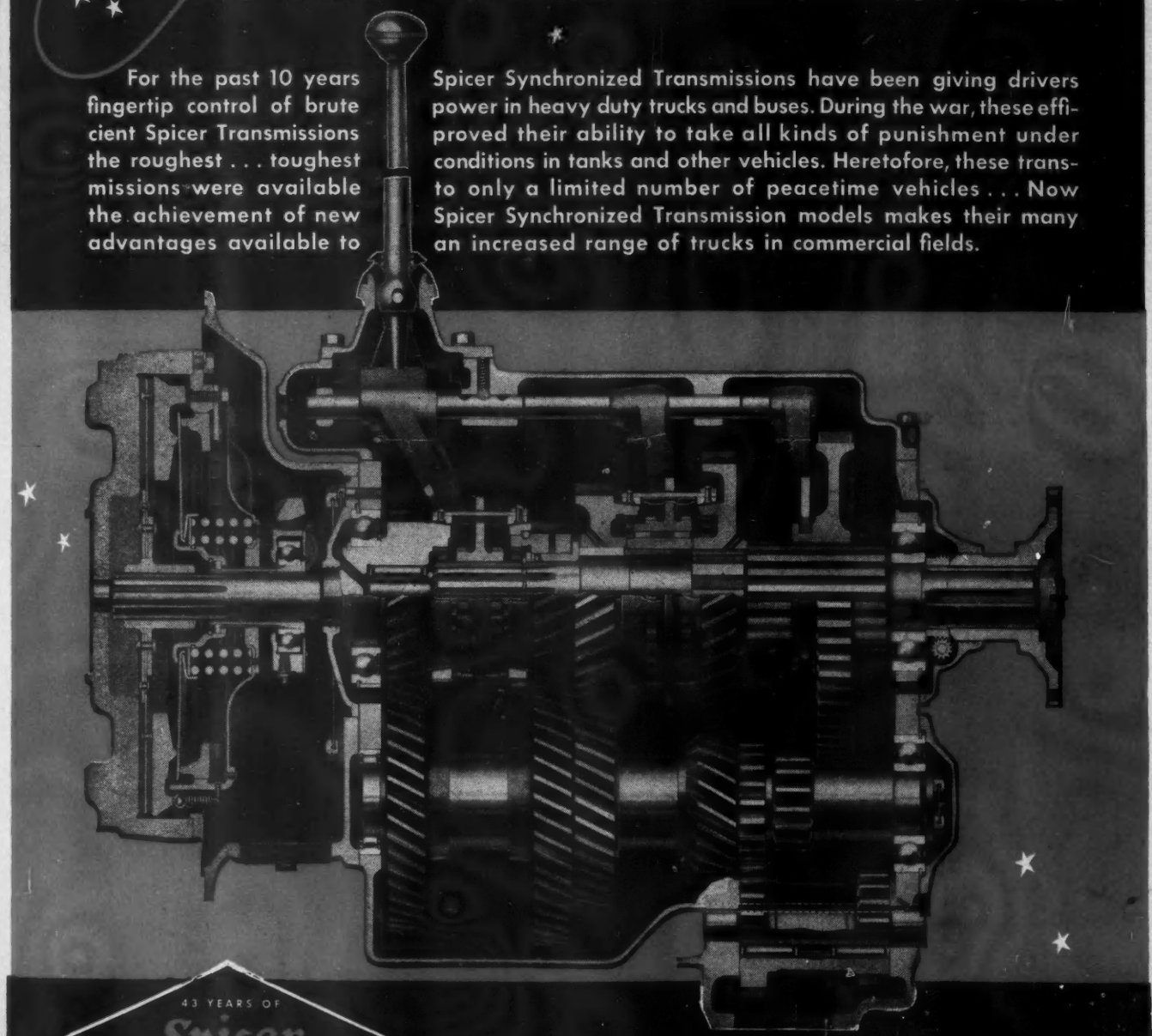
THE NEW *Synchronized* TRANSMISSIONS

for wider service in the truck field

For the past 10 years Spicer Synchronized Transmissions have been giving drivers fingertip control of brute power in heavy duty trucks and buses. During the war, these efficient Spicer Transmissions proved their ability to take all kinds of punishment under the roughest . . . toughest conditions in tanks and other vehicles. Heretofore, these transmissions were available to only a limited number of peacetime vehicles . . . Now the achievement of new Spicer Synchronized Transmission models makes their many advantages available to an increased range of trucks in commercial fields.



43 YEARS OF Spicer SERVICE

SPICER MANUFACTURING

Division of Dana Corporation

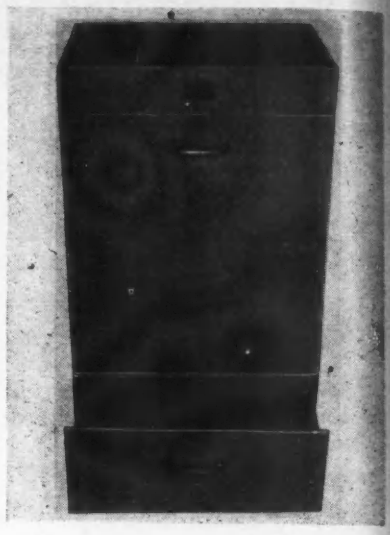
TOLEDO 1, OHIO

TRANSMISSIONS, TORQUE CONVERTERS, CLUTCHES, PASSENGER CAR AXLES, UNIVERSAL JOINTS, PARISH FRAMES, STAMPINGS, SPICER "BROWN-LIPE" GEAR BOXES

New Production Equipment

(*Continued from page* 43)

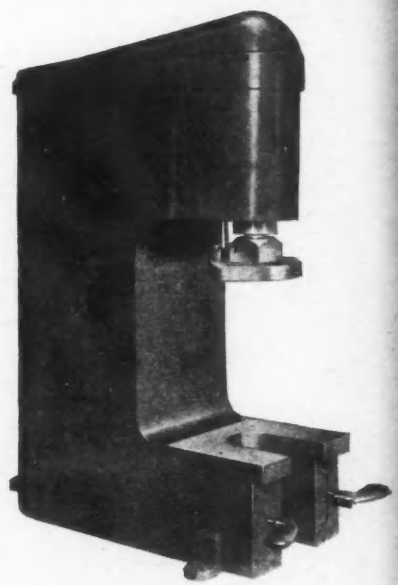
AN INNOVATION in portable dust collectors has been introduced by the Dust Filter Co., 1753 W. Lake St., Chicago 12, Ill. The new collector is called the Dustex dust collector. Unlike units which depend solely upon the filter tubes to separate the dust from the air, this unit causes the separation of high percentage of the dust at the point of intake. A baffle plate that is placed beneath the filter tubes causes a rotation of the air and dust in a cyclone manner into the retaining pan at the bottom of the unit, resulting in a deposit of the dust at that point before it has an opportunity to reach the filter tubes. All remaining fine dust is collected in the tubes. A static pressure of 6½ in. is maintained constantly. The unit comes in one size only. It is 4 ft high and approximately 2 ft square. It is equipped with a



Dustex dust collector

1½-hp, three-phase 220-440 volt motor and can handle two 4-in. branch pipes.

BRYANT PRODUCTS CO., Jackson, Mich., is making a new five-ton air-hydraulic press for operation from any air line having sufficient pressure and volume. A synthetic rubber "O" ring is used in this press. All inside surfaces



Bryant press

of the air cylinder which could contain moisture are "hard chromium plated." This assures that corrosion will not interfere with proper performance. Each press is equipped with an oil reservoir, which automatically maintains the proper constant volume of oil, in the hydraulic system.

THE LINCOLN ELECTRIC CO., Colt Rd. and Kirby Ave., Cleveland 1, Ohio, has just brought out its new "Fleet-Arc" AC welder equipped with the "Arc Booster."

(*Turn to page* 86, *please*)

Johnson TAPPETS

By Manufacturers of Tappets Exclusively

GIVE YOU . . . .

✓ SPECIALIZED DESIGN

✓ SPECIALIZED PRODUCTION

✓ SPECIALIZED SERVICE

The millions of **JOHNSON** Tappets in use today testify to the value of doing business with a concern whose business is tappets. By integrating years of engineering experience and skilled craftsmanship with the production of tappets exclusively, **JOHNSON** has become recognized as a leading manufacturer of all types of precision tappets. As a result of this specialization, **JOHNSON** Tappets are of superior design and construction . . . built to improve engine performance, last longer, and give better service.

JOHNSON engineers will give you the benefit of these advantages in discussing the tappet applications in your engines.

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MUSKEGON, MICHIGAN
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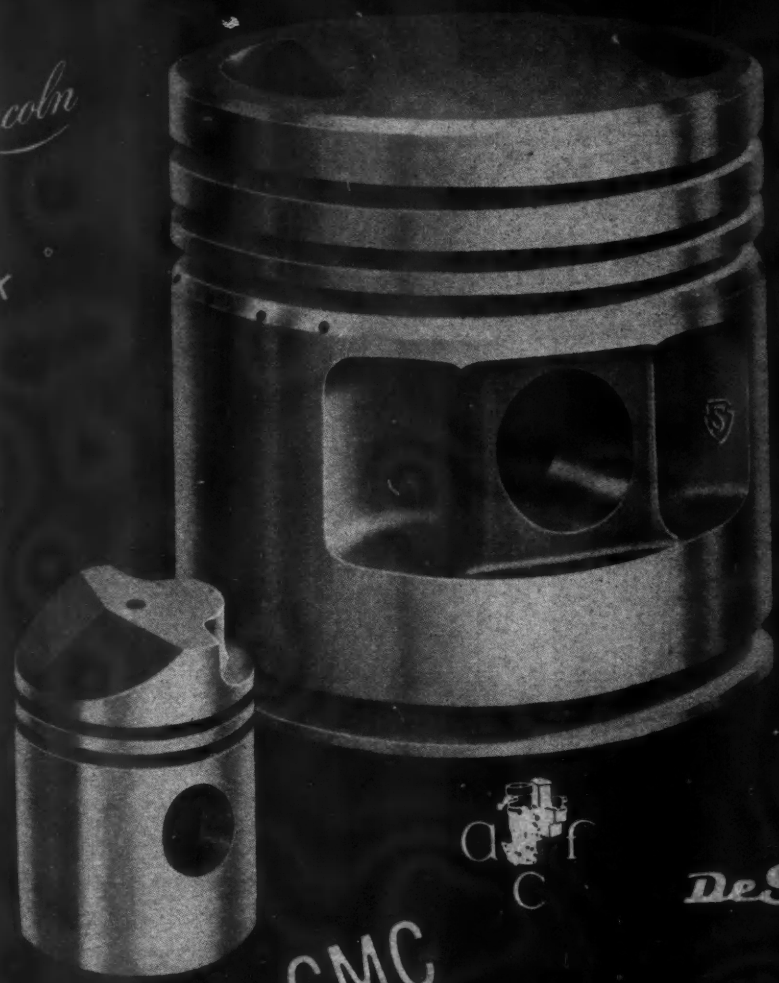

Ingersoll Rand

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STERLING

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Serving the Majority of the Most Discerning Accounts in the Automotive Industry for Over 25 Years

STERLING ALUMINUM PRODUCTS, INC. ST. LOUIS, MO.

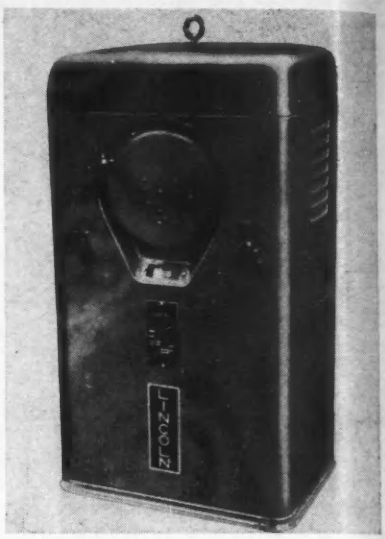
The "Arc Booster" augments the current the instant the arc is struck. The arc is started automatically the moment the electrode touches the work. This added feature of the new welder has been accomplished without the use of special high frequency devices or higher voltage.

A selector switch on the front of the welder governs the amount of booster current to be used in striking the arc. This provides a complete range of striking intensity to suit requirements in the welding of thin sheets or heavy plates, making of tack welds, or in the use of various types and sizes of electrodes.

Current control, continuous and self-adjusting, is provided by the rotating reactor control. Amperage is indicated on a calibrated dial on the face of the welder. The reactor current control is held in position by cone brakes and actuated by a self-cleaning chain drive.

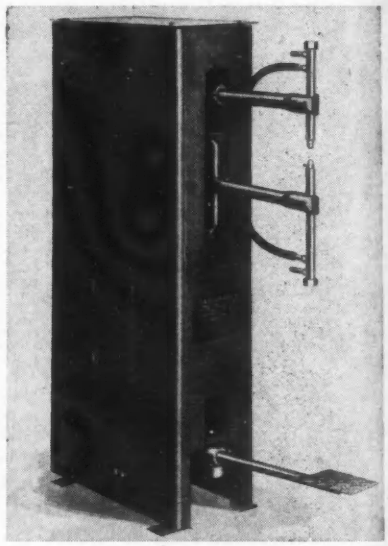
The "Fleet-Arc' AC welder, manufactured in 200, 300 and 500-amp range, has both frame and housing of all-welded construction.

OFFERED to the trade by the Taylor-Hall Welding Corp., subsidiary of the Federal Machine and Welder Co., Warren, Ohio, is a new press type spot welder which applies welding pressure



Lincoln "Fleet-Arc" AC welder

in a straight vertical movement of the upper electrode, representing a departure from the radial pressure approach of the rocker arm type. The vertical ram on which the upper horn is mounted rides on V-shaped slides 20 in. long.



New press type spot welder

The lower horn has a vertical adjustment of 6 in. and swing adjustment through 90 degrees. The upper horn may be adjusted 1 in. out beyond the end of the lower horn. The back and sides of the machine are completely flush, valves and switches being recessed in the side panel. The machine also offers new transformer design requiring less input for maximum welding power. Ratings are available in 5 and 10 kva capacities.

ZAGAR TOOL, INC., 23880 Lakeland Blvd., Cleveland 17, Ohio, has designed a special collet fixture that increases the usefulness of standard plain grinding machines. Used to grind

(*Turn to page* 90, *please*)

Portal-to-Portal Delivery with Trail-Car TUTHILL-Springs Equipped

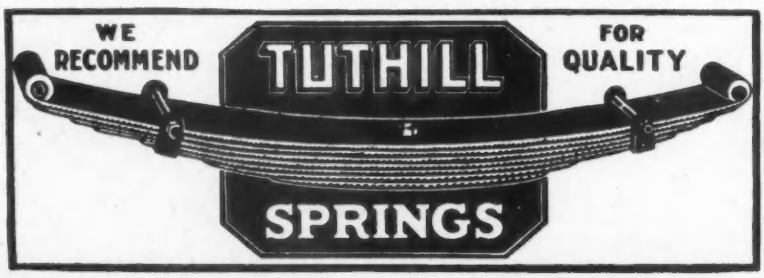
THIS 25-ton Trail Car, built by AUSTIN-WESTERN CO., Aurora, Ill., is used for hauling coal from strip mines.

Equipped with TUTHILL Alloy Steel Springs, this Trail Car hauls big loads safely over rough ground.

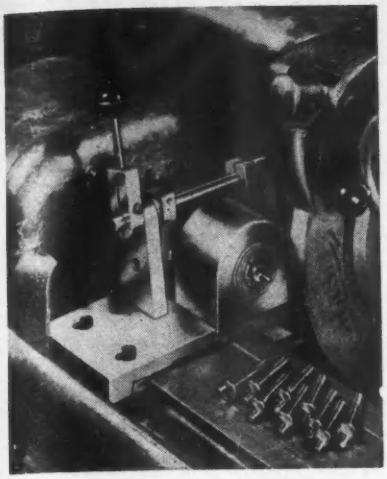
Severely tested in service, TUTHILL stands up. Built into its leaf springs are *toughness, resilience, durability.*

TUTHILL makes a complete line of steel leaf-type springs, standard or special. What are your requirements?

TUTHILL SPRING COMPANY • 760 W. POLK STREET CHICAGO 7, ILL.



Quality Leaf Springs for Sixty-Six Years

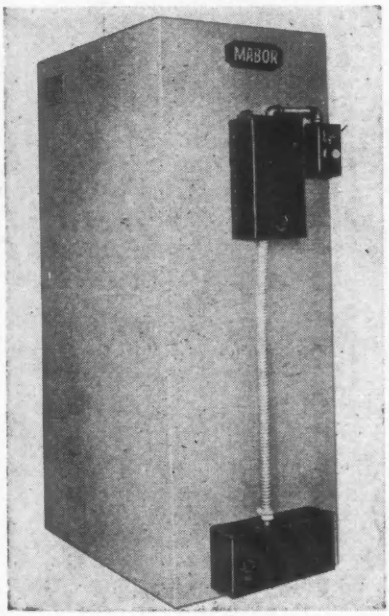


Zagar collet fixture

parts without centers, which can be held in collets, this tool runs on its own ball bearings and is driven by the headstock of the machine. The collet can be opened and closed while the grinder is running. Because the collet does not move lengthwise, it is possible to hold overall dimensions.

This Zagar collet tool is said to be adaptable to any make or model of grinder. Its use involves no extra or special attachments.

Mabor Degreaser



An improved vapor degreaser embodying a controlled cool-air principle is offered by the Mabor Co., Rahway, N. J. The degreaser is self-distilling and contains built-in storage tanks. By increasing the flow of cooling air, vapor level oscillation is substantially reduced, and the consumption of solvent is also reduced proportionately. An extra heater, food petal operated, helps to increase the vapor formation and overcome the shock load as work is placed in the machine. A hand hose and flush pump are supplied with the machine to take care of lighter gauges which do not condense enough solvent vapor for effective cleaning

Complete Your Production Picture

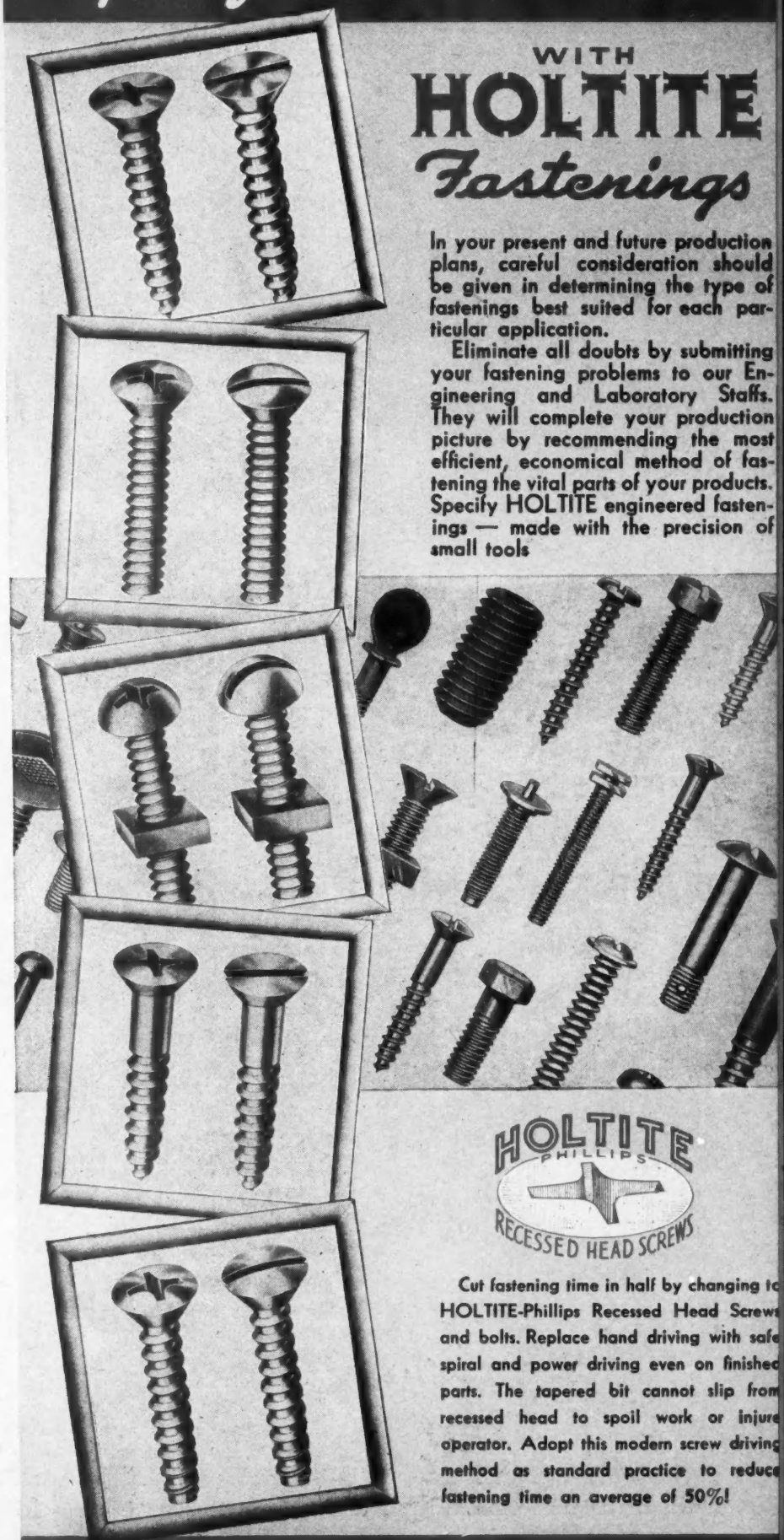
WITH

HOLTITE

Fastenings

In your present and future production plans, careful consideration should be given in determining the type of fastenings best suited for each particular application.

Eliminate all doubts by submitting your fastening problems to our Engineering and Laboratory Staffs. They will complete your production picture by recommending the most efficient, economical method of fastening the vital parts of your products. Specify HOLTITE engineered fastenings — made with the precision of small tools



HOLTITE PHILLIPS RECESSED HEAD SCREWS

Cut fastening time in half by changing to HOLTITE-Phillips Recessed Head Screws and bolts. Replace hand driving with safe spiral and power driving even on finished parts. The tapered bit cannot slip from recessed head to spoil work or injure operator. Adopt this modern screw driving method as standard practice to reduce fastening time an average of 50%!

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. . . VACDRAULIC, a **Kelsey-Hayes** precision product, is becoming the choice of more and more manufacturers of cars, trucks and buses as standard equipment for safely boosting the hydraulic braking system. **VACDRAULIC** is a superior, sealed unit, with all moving parts inside . . . **VACDRAULIC** is easier to mount . . . connects only to hydraulic line and engine intake manifold . . . multiplies brake power many times, yet gives driver perfect feather-touch pedal control with proper "brake-feel" at all times. (Manufacturers: inquiries being accepted at Kelsey-Hayes . . . Automotive Distributors: please contact Empire Electric Brake Co., Newark 7, N. J.)

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